Models Covered In This Manual

Model	Serial Number or Year
All Bravo Models	0M100000 and Above
Sport Master Models	0M052945 and Above

Notice

Throughout this publication, “Dangers,” “Warnings” and “Cautions” (accompanied by the International HAZARD Symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. **OBSERVE THEM CAREFULLY!**

These “Safety Alerts” alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus “Common Sense” operation, are major accident prevention measures.

⚠ DANGER

DANGER - Immediate hazards which WILL result in severe personal injury or death.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

Hazards or unsafe practices which could result in minor personal injury or product or property damage.

Notice to Users of This Manual

This service manual has been written and published by the Service Department of Mercury Marine to aid our dealers’ mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures of these products, or like or similar products manufactured and marketed by Mercury Marine, that they have been trained in the recommended servicing procedures of these products which includes the use of mechanics’ common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

It should be kept in mind, while working on the product, that the electrical system and ignition system are capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note, during any maintenance procedure replacement fasteners must have the same measurements and strength as those removed. Numbers on the heads of the metric bolts and on the surfaces of metric nuts indicate their strength. American bolts use radial lines for this purpose, while most American nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for reuse in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

We reserve the right to make changes to this manual without prior notification.

Refer to dealer service bulletins for other pertinent information concerning the products described in this manual.

Engine Mechanical Components

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide-open-throttle operation and, therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications which are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt or brackish water that will rust or corrode standard automotive parts within a short period of time.

Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durability, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Use of parts other than recommended service replacement parts, will void the warranty on those parts which are damaged as a result of the use of other than recommended replacement parts.

Replacement Parts

⚠ WARNING

Electrical, ignition and fuel system components on Mercury MerCruiser Engines and Sterndrives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing the electrical, ignition and fuel systems, it is extremely important that all components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.

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- C - Troubleshooting

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- B - Gear Housing - Bravo One
- C - Gear Housing - Bravo Two
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- A - Oildyne Power Trim Pump
- B - Trim Cylinders
- C - Dual Power Trim Control

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CORROSION PROTECTION

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IMPORTANT INFORMATION

Section 1A - General Information

1 A

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Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment to enable dealers and service mechanics to repair these products.

Before attempting repairs, it is suggested that the procedure first be read through to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

How To Use This Manual

This manual is divided into sections, which represent major components and systems.

Some sections are further divided into parts that more fully describe the component.

Refer to the Service Manual Outline following Models Covered In This Manual for section titles.

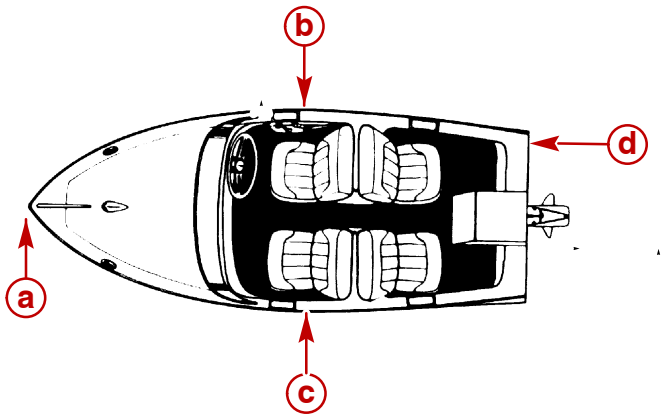
Page Identification

The service manual number and section title appear at the top of the page. Two number groups appear at the bottom of each page. Following is an example and a description.

a - Section number
b - Section part
c - Page number
d - Manual number
e - Revision number
f - Month printed
g - Year printed

Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this service manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



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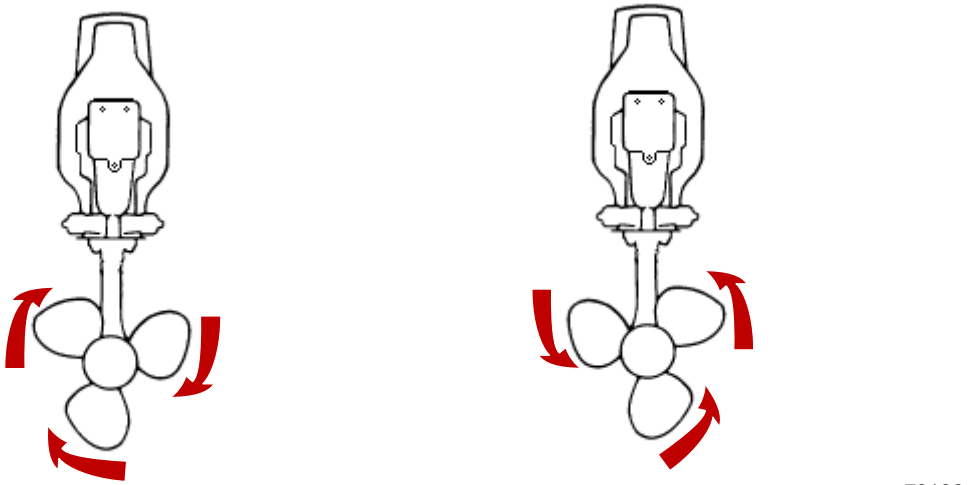
a - Fore or bow (front)
b - Starboard (right)
c - Port (left)
d - Aft or stern (rear)

Propeller Rotation

Propeller rotation for sterndrive can be right-hand or left-hand rotation as viewed from the aft end of the propeller.



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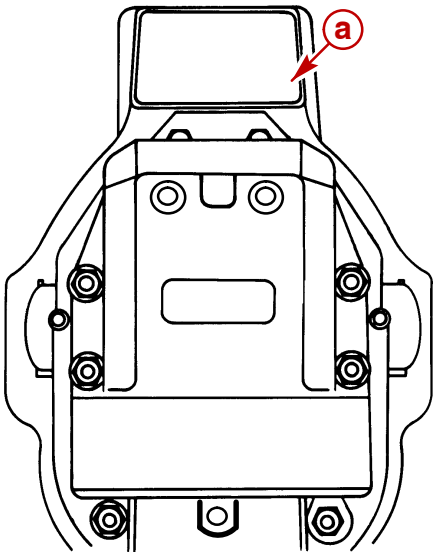
Right-hand rotation **Left-hand rotation**

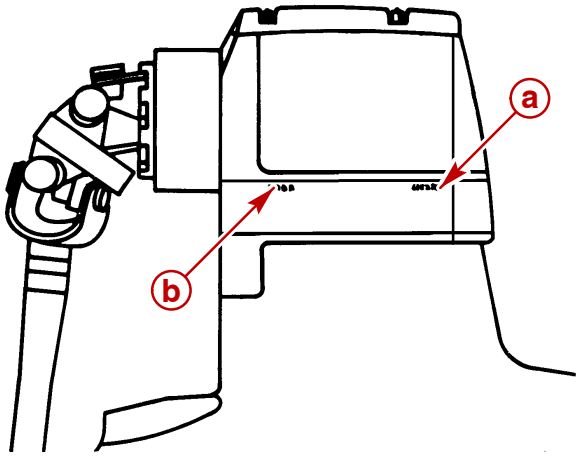
Sterndrive Unit 10-Hour Break-In Period (New or With Replacement Gears)

- Avoid full throttle starts.
- Do not operate at any one constant speed for extended periods of time.
- Do not exceed 75% of full throttle during the first 5 hours. During the next 5 hours, operate at intermittent full throttle.
- Sterndrive unit should be shifted into forward gear a minimum of 10 times during break-in, with run-in time at moderate rpm after each shift.

Serial Number Locations



a - Transom assembly serial number



Port side decal

a - Sterndrive unit serial number
b - Sterndrive unit gear ratio

IMPORTANT INFORMATION

Section 1B - Maintenance

1 B

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Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

Description	Nm	lb-in.	lb-ft
Oil fill/drain plug	4.5	40	
Oil vent plug	4.5	40	

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
Mercury Light Gray Primer	Painted surfaces	92-802878 52
Mercury Phantom Black		92-802878Q 1
Corrosion Guard	Painted surfaces	92-802878-55
Engine Oil	Pivot points, guide contact surfaces	Obtain locally
Special Lubricant 101	Steering cable	92-802865A1
	Propeller shaft	
SAE 30W Engine Oil	Tie bar pivot points	Obtain locally
	Steering system pivot points	
U-joint And Gimbal Bearing Grease	Gimbal bearing	92-802870A1
	Drive shaft U-joints	
Engine Coupler Spline Grease	Coupler	92-802869A1
	U-joint shaft splines and O-rings	
High Performance Gear Lube	Gear lube monitor	92-802854A1
	To fill sterndrive	
Liquid Neoprene	Clamps and terminals	92-25711-3
2-4-C with Teflon	Steering cable	92-802859A1
	Propeller shaft	
Anti-Corrosion Grease	Propeller shaft	92-802867A1

Approved Hydraulic Steering Fluids

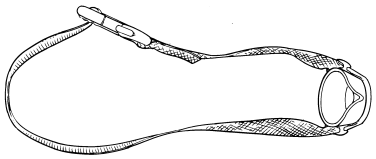
Description	Part Number
Hydraulic Helm Steering Fluid	92-862014A1
SeaStar® Hydraulic Fluid HA5430	Obtain locally
Chevron® Aviation Fluid	
Mobil® Aero HFA	
Shell® Aero 4	
Hydraulic Fluid meeting MIL Specification H5606C	

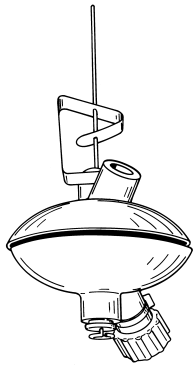
Fluid Capacities

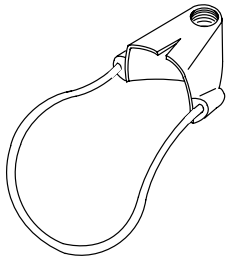
NOTICE
Unit Of Measurement: Milliliters (Fluid Ounces)
All capacities are approximate fluid measures.

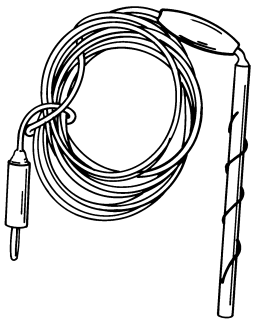
Model	Bravo One	Bravo Two	Bravo Three
Sterndrive unit oil capacity	2602 ml. (88 fl oz)	3076 ml. (104 fl oz)	2839 ml. (96 fl oz)

Special Tools

Dual Water Pick-Up Flush Gear Case Seal Kit		
 77977	Use to block-off the front water inlet holes on the dual water inlet gear cases.	91-881150Q1

Flushing Device		
 73440	Attaches to the sterndrive unit water intakes; provides a fresh water connection when flushing the cooling system or operating the engine.	91-44357Q2

Flushing Kit		
 78135	Use for flushing sterndrives with low water inlet gear cases.	91-84996T1

Reference Electrode		
 73446	Senses an electrical current in the water when testing the MerCathode system. Use to check hull potential.	91-76675T1

Maintenance Schedules

Maintenance Intervals

Maintenance intervals and the corresponding tasks to be performed, as shown in this current schedule or as found in a previously printed schedule, are generally based on an average boating application and environment. However, individual operating habits and personal maintenance preferences can have an impact on the suggested intervals. In consideration of these factors, Mercury MerCruiser has adjusted some maintenance intervals and the corresponding tasks to be performed. In some cases, this may allow for more individual tasks in a single visit to the servicing dealer. Therefore, it is very important that the boat owner and the servicing dealer discuss the current Maintenance Schedule and develop appropriate maintenance intervals to coincide with the individual operating habits, the environment and the maintenance requirements.

⚠ CAUTION

Always disconnect battery cables from battery BEFORE working around electrical systems components to prevent injury to yourself and damage to electrical system should a wire be accidentally shorted.

Gas Sterndrive

Routine Maintenance *	Each Day Start	Each Day End	Weekly	Every Two Months
Check sterndrive unit oil level, trim pump oil level and steering fluid level.			●★	
Check water pickups for debris or marine growth. Check water strainer and clean. Check coolant level.			●★	
Inspect sterndrive unit anodes and replace if 50 percent eroded.			●★	
Lubricate propeller shaft and the retorque nut (if operating in only freshwater, this maintenance may be extended to every four months).				●★

* Only perform maintenance that applies to your particular power package

● Standard models

★ Horizon models

Gas Sterndrive (continued)

Scheduled Maintenance *	Annually	Every 100 hours or Annually	Every 200 hours or 3 years	Every 300 hours or 3 years	Every 2 years	Every 5 years
Touch-up power package paint and spray with Corrosion Guard.	●★					
Change sterndrive unit oil and retorque connection of gimbal ring to steering shaft.		●★				
Check steering system and remote control for loose, missing or damaged parts. Lubricate cables and linkages.		●★				
Inspect U-joints, splines and bellows. Check clamps. Check engine alignment. Lubricate U-joints splines.		●◆	★			
Lubricate gimbal bearing and engine coupler.		●8◆	★			
Check continuity circuit for loose or damaged connections. Test MerCathode® unit output on Bravo Models.		●◆	★			

* Only perform maintenance that applies to your particular power package

● Standard models

★ Horizon models

8 Lubricate engine coupler every 50 hours if operated at idle for prolonged periods of time or if used in heavy boat applications.

◆ Later standard-models can be serviced every 200 hours or 3 years.

Corrosion

Refer to the ***Mercury Precision Parts / Marine Corrosion Protection Guide*** (90-881813003).

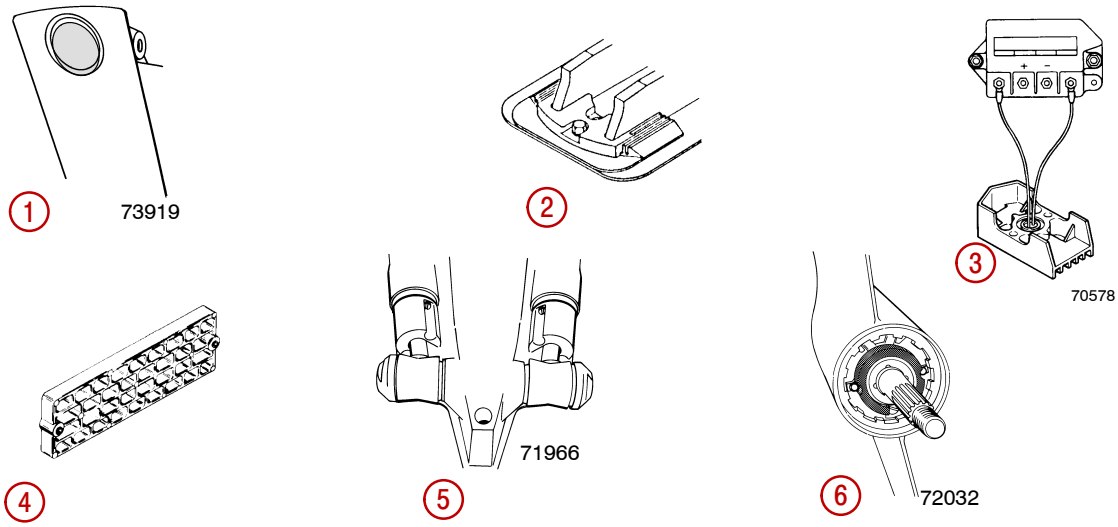
Maintaining Ground Circuit Continuity

The transom assembly and sterndrive unit are equipped with a ground wire circuit to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the MerCathode System to function effectively. Refer to **Section 7**.

Maintaining Anodic Protection

Each sterndrive unit is equipped with a sacrificial anodic plate to help protect underwater metal parts from galvanic corrosion. Because of its self-sacrificing nature, anodic plate MUST BE replaced if eroded 50% or more. Refer to **Section 7**.

IMPORTANT: Replace sacrificial anodes if eroded 50 percent or more.



Common sacrificial anodes and MerCathode system

1 - Universal anodic plate
2 - Anodic plate
3 - MerCathode system
4 - Anode kit (if equipped)
5 - Trim cylinder anodes
6 - Bearing carrier anode (Bravo One)

Universal Anodic Plate - serves as a sacrificial anode.

Anodic Plate - serves as a sacrificial anode.

MerCathode System - standard on Bravo.

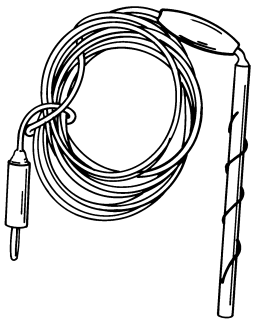
Anode Kit (if equipped) - mounted to boat transom. Acts as a sacrificial anode.

Trim Cylinder Anodes - mounted on each trim cylinder.

Bearing Carrier Anode (Bravo One) - located in front of the propeller, between the front side of the propeller and the gear housing.

Checking Quicksilver MerCathode System

The MerCathode system should be tested to ensure adequate output. The test should be performed where boat is moored, using the Reference Electrode and Test Meter. Refer to **Section 7**.

Reference Electrode		
 73446	Senses an electrical current in the water when testing the MerCathode system. Use to check hull potential.	91-76675T1

Maintaining Power Package Exterior Surfaces

1. Spray entire power package at recommended intervals with Corrosion Guard. Follow instructions on can for proper application.

Description	Where Used	Part Number
Corrosion Guard	Painted surfaces	92-802878-55

2. Clean entire power package. External surfaces that have become bare should be repainted with Primer and Spray Paint at recommended intervals.

Description	Where Used	Part Number
Mercury Light Gray Primer	Painted surfaces	92-802878 52
Mercury Phantom Black		92-802878Q 1

Boat Bottom Care

To achieve maximum performance and fuel economy, boat bottom MUST BE kept clean. Accumulation of marine growth or other foreign matter can greatly reduce boat speed and increase fuel consumption. To ensure best performance and efficiency, periodically clean boat bottom in accordance with manufacturer’s recommendations.

In some areas, it may be advisable to paint the bottom to help prevent marine growth. Refer to the following information for special notes about the use of anti-fouling paints.

Anti-fouling Paint

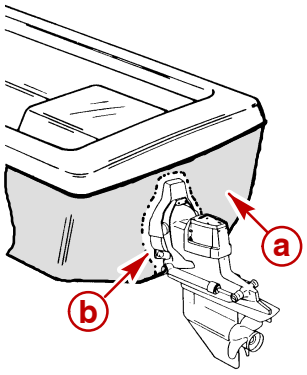
IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint will not be covered by the limited warranty.

Painting Boat Hull or Boat Transom: Anti-fouling paint may be applied to boat hull and boat transom but you must observe the following precautions:

IMPORTANT: Do not paint anodes or MerCathode System reference electrode and anode, as this will render them ineffective as galvanic corrosion inhibitors.

IMPORTANT: If anti-fouling protection is required for boat hull or boat transom, copper base paints, if not prohibited by law, can be used. If using copper based anti-fouling paints, observe the following:

- **Avoid an electrical interconnection between the Mercury MerCruiser product, anodic blocks, or MerCathode system and the paint by allowing a minimum of 40 mm (1-1/2 in.) UNPAINTED area on transom of the boat around these items.**



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a - Painted boat transom
b - Minimum 40 mm (1-1/2 in.) UNPAINTED area around transom assembly

NOTE: *Sterndrive unit and transom assembly can be painted with a good quality marine paint or an anti-fouling paint that does not contain copper or any other material that could conduct electrical current. Do not paint drain holes, anodes, MerCathode system, and items specified by boat manufacturer.*

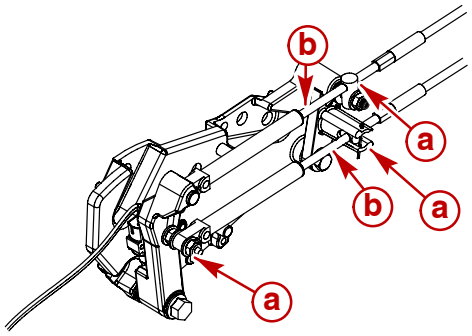
Steering Head and Remote Control Maintenance

1. Lubricate steering head and remote control at recommended intervals. Inspect steering head and remote control for ease of operation.

Description	Where Used	Part Number
Engine Oil	Pivot points, guide contact surfaces	Obtain locally

Shift Cable

1. Lubricate the pivot points and the guide contact surfaces.



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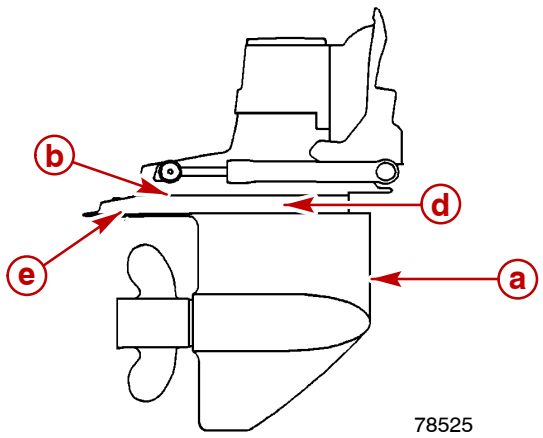
Typical

a - Pivot points
b - Guide contact surfaces

Description	Where Used	Part Number
Engine Oil	Pivot points, guide contact surfaces	Obtain locally

Sterndrive Water Drain Holes

1. Using a piece of wire, check water drain holes in sterndrive unit to ensure that they are open.



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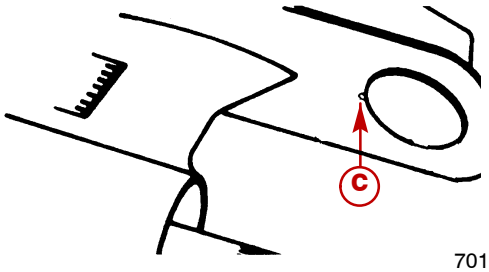

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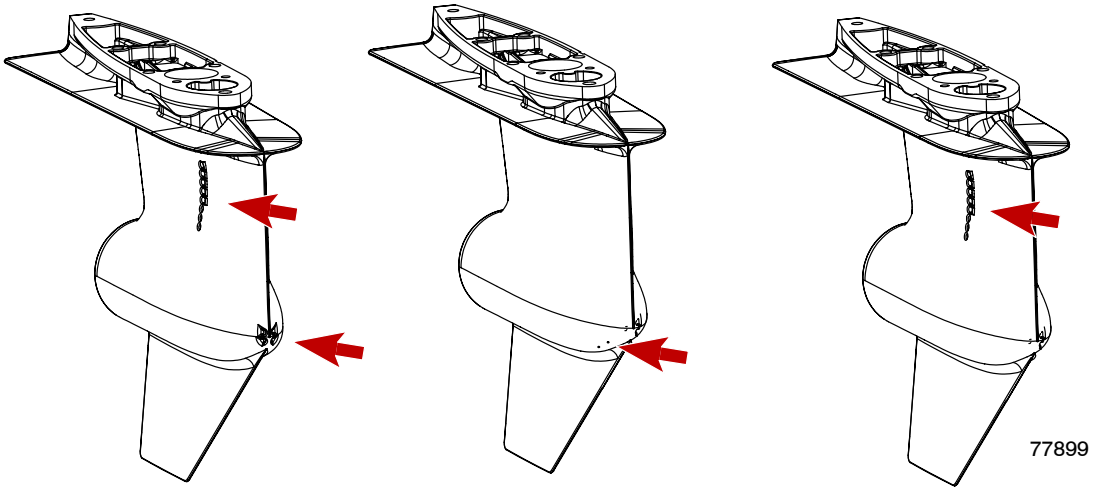
Sterndrive unit water drain holes

- **a** - Speedometer pitot tube
- **b** - Anode cavity vent hole
- **c** - Anode cavity drain passage
- **d** - Gear housing water drain hole (1 each - port and starboard)
- **e** - Gear housing cavity vent hole (Bravo II only)

Sterndrive Water Pickups

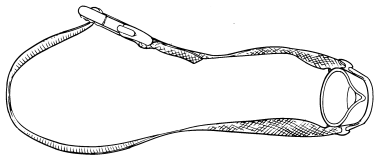
IMPORTANT: Bravo models equipped with closed cooling require dual water pickups and must be equipped with a through the hull or through the transom pickup in addition to the sterndrive water inlets.

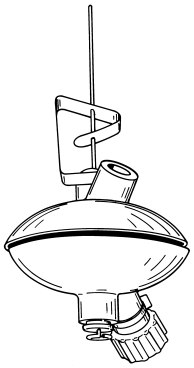
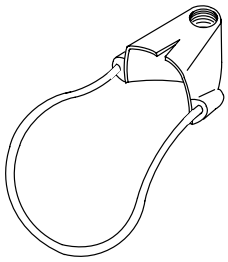
There are 3 types of water pickups available on Mercury MerCruiser sterndrives: low water, dual water, and side pickups. Dual water pickups require the Flushing Device (92-44357Q2) and the Dual Water Pick-Up Flush Gear Case Seal Kit (92-881150Q1), low water pickups require the Flushing Kit (92-849996T1), and side pickups require the Flushing Device (92-44357Q2).



Dual water pickup **Low water pickup** **Side pickup**

FLUSHING ATTACHMENTS

Dual Water Pick-Up Flush Gear Case Seal Kit		
 77977	Use to block-off the front water inlet holes on the dual water inlet gear cases.	91-881150Q1

Flushing Device		
 73440	Attaches to the sterndrive unit water intakes; provides a fresh water connection when flushing the cooling system or operating the engine.	91-44357Q2
Flushing Kit		
 78135	Use for flushing sterndrives with low water inlet gear cases.	91-84996T1

0194.2

NOTE: *Flushing is needed only for salty, brackish, mineral laden or polluted water applications. Flushing is recommended after each outing for best results.*

⚠ CAUTION

If flushing with the boat in the water, seawater can flow into the engine causing engine damage. Water inlet must be closed when flushing the engine.

1. Drain the seawater section of the cooling system.
2. **Seawater cooled Models:** Proceed to Step 4. or Step 5.
3. **Closed Cooled models could require a through the hull or through the transom water inlet and sterndrive water inlets. Verify your model as follows:**
   a. If you have a Bravo sterndrive unit and closed cooling (equipped with a heat exchanger on the front of the engine), verify that a hose is connected between the transom and the y-fitting and between the sea strainer and the y-fitting.
   b. If there is a hose running to the transom, shut the seacock located in the hose between the sea strainer and the y-fitting. Proceed to Step 4. or Step 5.
   c. If there is not a hose running to the transom, refer to Alternative Water Pickups.
4. If flushing the cooling system with boat in water:
   a. Raise sterndrive unit to TRAILER position.
   b. Install appropriate flushing attachments over water intake openings in the gear housing.
   c. Lower sterndrive unit to full DOWN/IN position.
5. If flushing cooling system with boat out of water:
   a. Lower sterndrive unit to full DOWN/IN position.

⚠ WARNING

Contact with moving drive components and the propeller can cause personal injury or death. To avoid possible injury , remove the propeller and ensure that no people or animals are in the area of the drive unit while flushing.

   b. Remove propeller.
   c. Install appropriate flushing attachments over water intlets in gear housing.
6. Connect hose between flushing attachment and water source.
7. With sterndrive unit in normal operating position, partially open water source (about 1/2 maximum).

8. Place sterndrive in NEUTRAL, idle speed position and start engine.

⚠ CAUTION

Suction created by the seawater pickup pump may collapse the flushing water hose causing the engine to overheat. Avoid engine damage from overheating, Do NOT operate the engine above 1500 rpm.

9. Slowly advance throttle until engine reaches 1300 rpm (+/–100 rpm).

⚠ CAUTION

Engine overheating can cause engine damage. To avoid, observe the water temperature gauge and ensure that the engine is operating in the normal range.

10. Observe the water temperature gauge to ensure that the engine is operating in the normal range.
11. Operate engine with sterndrive in NEUTRAL for about 10 minutes or until discharge water is clear.
12. Slowly return throttle to idle speed position.
13. Stop engine.
14. Shut off water and remove flushing attachment.
15. Remove the seawater inlet hose from the seawater pump and plug the hose to prevent water from siphoning into the engine.
16. Tag the ignition switch with an appropriate tag requiring the seawater inlet hose to be reconnected prior to operating engine.

0195.2

Alternative Water Pickups

IMPORTANT: Two water sources are needed for this procedure.

NOTE: *Flushing is needed only for salty, brackish, mineral laden or polluted water applications. Flushing is recommended after each outing for best results.*

1. Drain the seawater section of the cooling system.

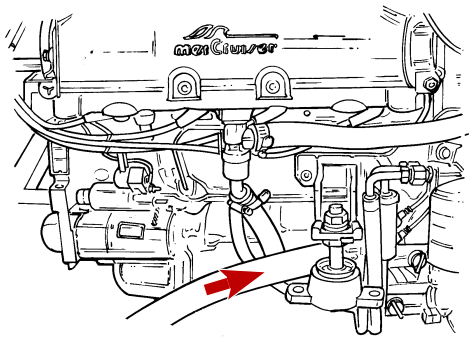
IMPORTANT: Engines with the sterndrive water inlet blocked off at the gimbal housing and using a through the hull water inlet need a supply of cooling water available to both the sterndrive unit and to the engine during operation.

2. If flushing cooling system with boat in water:
   a. Raise sterndrive unit to TRAILER position.
   b. Install appropriate flushing attachment over the water intake openings in the gear housing.
   c. Lower sterndrive unit to full DOWN/IN position.
   d. Proceed to Step 4.
3. If flushing cooling system with boat out of water:
   a. Lower sterndrive unit to full DOWN/IN position.

⚠ WARNING

Contact with moving drive components and the propeller can cause personal injury or death. To avoid possible injury , remove the propeller and ensure that no people or animals are in the area of the drive unit while flushing.

   b. Remove propeller.
   c. Install appropriate flushing attachments over water inlets gear housing.
4. Connect hose between flushing attachment and water source.
5. Disconnect the water inlet hose (upper hose) from the aft side of the seawater pump.



77945

6. Plug the seawater inlet hose or close the seacock to prevent water from siphoning into the boat.

7. Using a suitable adapter, connect the flushing hose from the water source to the water inlet of the seawater pump.

⚠ CAUTION

Overheating from insufficient cooling water will cause engine and drive system damage. Ensure that there is sufficient water always available at water inlet holes during operation.

8. With sterndrive unit in normal operating position, partially open the 2 water sources (about 1/2 maximum).
9. Place sterndrive in NEUTRAL, idle speed position and start engine.

⚠ CAUTION

Suction created by the seawater pickup pump may collapse the flushing water hose causing the engine to overheat. Avoid engine damage from overheating, Do NOT operate the engine above 1500 rpm.

10. Slowly advance throttle until engine reaches 1300 rpm (+/–100 rpm).

⚠ CAUTION

Engine overheating can cause engine damage. To avoid, observe the water temperature gauge and ensure that the engine is operating in the normal range.

11. Observe the water temperature gauge to ensure that the engine is operating in the normal range.
12. Operate engine with sterndrive in NEUTRAL for about 10 minutes or until discharge water is clear.
13. Slowly return throttle to idle speed position.
14. Stop engine.
15. Shut off water and remove flushing attachments.
16. **If the boat is out of the water:** Install the water inlet hose to the aft side of the seawater pump. Tighten the hose clamp securely.
17. **If the boat is in the water:** Tag the ignition switch with an appropriate tag requiring the seawater inlet hose to be reconnected prior to operating engine.

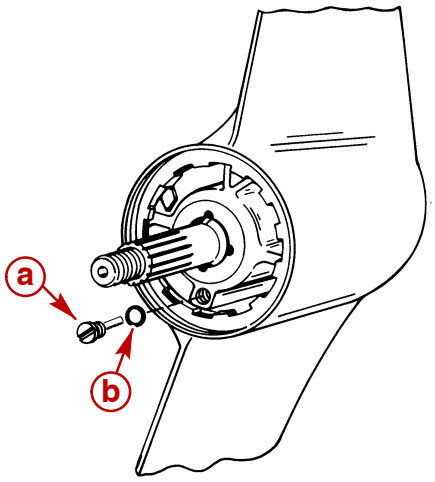
Sterndrive Unit Oil

Checking

1. Periodically inspect oil for water to ensure that sterndrive unit seals are not leaking.
2. Check for water at bottom of gear lube monitor. If a water leak is indicated, the sterndrive unit must be resealed.

IMPORTANT: If sterndrive unit has set overnight or longer, check for water in sterndrive unit.

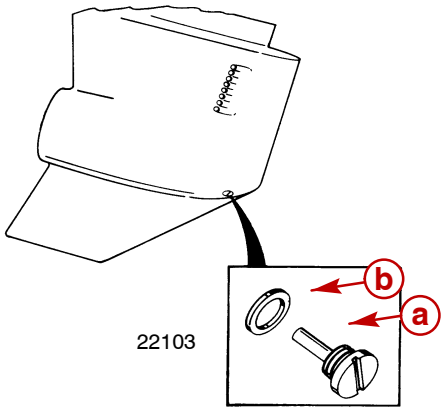
a. **Bravo I:** Trim sterndrive unit to full DOWN/IN position.



70023

a - Oil fill/drain plug
b - Sealing washer

b. **Bravo II and III:** Trim sterndrive unit to full UP/OUT position.



22103

22101

a - Oil fill/drain plug
b - Sealing washer

c. Remove fill/drain plug. If water runs out, sterndrive unit is leaking and **must** be resealed.

d. Reinstall fill/drain plug and torque.

Description	Nm	lb-in.	lb-ft
Fill/drain plug	4.5	40	

Filling

IMPORTANT: Position sterndrive unit in DOWN/IN position so that anti-ventilation plate is level.

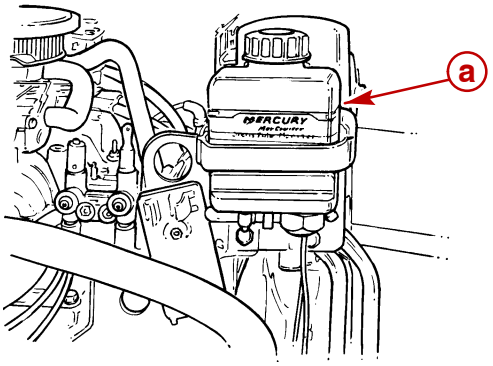
⚠ CAUTION

If more than 59 ml (2 fl oz) of oil is required to fill sterndrive unit, an oil leak may exist. Find and correct cause of leak before unit is placed in operation.

NOTE: *Sterndrive unit oil level is checked at gear lube monitor.*

IMPORTANT: Oil level in gear lube monitor will rise and fall during sterndrive operation; always check oil level when sterndrive is cool and engine is shut down.

NOTE: *Oil will purge from gear lube monitor if rubber gasket is not in cap.*



77813

a - Gear lube monitor full line / operating range

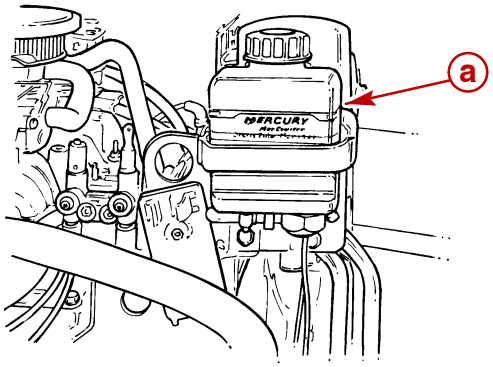
1. Fill gear lube monitor to FULL line / OPERATING range
2. Ensure that rubber gasket is installed in gear lube monitor cap.
3. Install gear lube monitor cap. Tighten cap 1/4 turn after monitor contacts gasket.

IMPORTANT: Do not overtighten cap.

4. Check oil level in gear lube monitor.

Changing

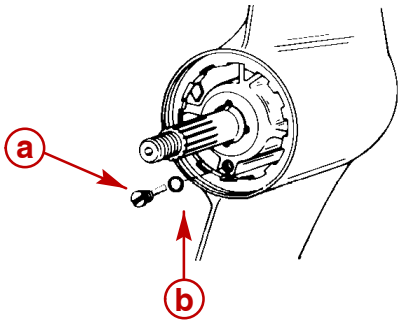
1. Remove the gear lube monitor from the bracket.



77813

a - Gear lube monitor

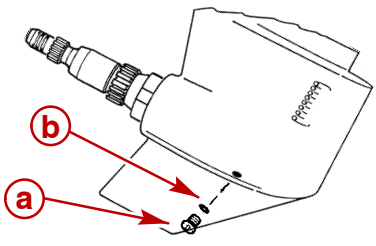
2. Empty the contents into a suitable container.
3. Install the monitor in the bracket.
4. **Bravo One Models:** Remove the propeller, place the sterndrive unit in full trim limit IN position, remove the oil fill/drain screw and sealing washer and drain the oil.



70568

a - Oil fill/drain
b - Sealing washer

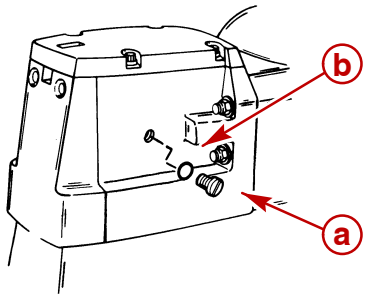
5. **All Other Models:** Place the sterndrive unit in full trim limit OUT position, remove the oil fill/drain screw and sealing washer and drain the oil.



72522

a - Oil fill/drain
b - Sealing washer

6. Remove the oil vent screw and sealing washer. Allow the oil to drain completely.



77106

a - Oil vent screw
b - Sealing washer

IMPORTANT: If any water drained from the oil fill/drain hole, or if the oil appears milky, the sterndrive unit is leaking and should be checked immediately by your authorized Mercury MerCruiser dealer.

7. Lower the sterndrive unit so that the propeller shaft is level. Fill the sterndrive unit through the oil fill/drain hole, with specified gear lube until an air-free stream of lubricant flows from oil vent hole.

Description	Where Used	Part Number
High Performance Gear Lube	Gear lube monitor	92-802854A1

IMPORTANT: Use only High Performance Gear Lube in sterndrive unit.

8. Install the oil vent screw and sealing washer.
9. Continue to pump gear lube into the gear lube monitor circuit until the gear lube appears in the gear lube monitor.
10. Fill the monitor so that the oil level is in the operating range. Do not overfill. Ensure that the rubber gasket is inside the cap and install. Do not overtighten.

Description	Where Used	Part Number
High Performance Gear Lube	Gear lube monitor	92-802854A1

11. Remove the pump from the oil fill/drain hole. Quickly install the sealing washer and oil fill/drain screw. Tighten securely.
12. Reinstall the propeller.
13. Recheck the oil level after the first use.

IMPORTANT: Oil level in the gear lube monitor will rise and fall during sterndrive operation; always check the oil level when the sterndrive is cool and the engine is shut down.

Power Package Layup

Engine

Refer to appropriate Mercury MerCruiser Engine Service Manual.

Sterndrive

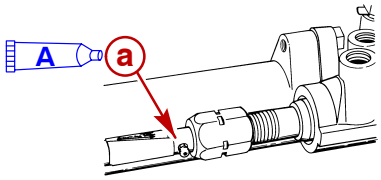
1. Lubricate the steering system.

⚠ WARNING

Do not grease steering cable while extended. Hydraulic lock could occur and cause loss of steering control.

a. **If steering cable has grease fittings:** Turn steering wheel until steering cable is fully retracted into cable housing. Apply approximately 3 pumps of grease from a typical hand-operated grease gun.

NOTE: *If steering cable does not have grease fitting, inner wire of cable cannot be greased.*

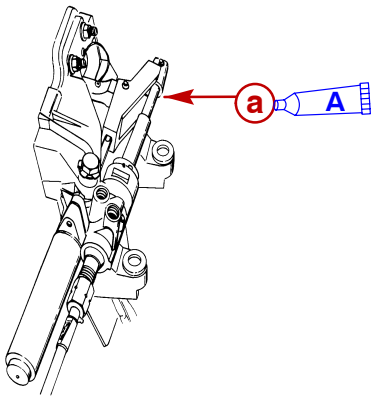


71903

a - Steering cable grease fitting

Description		Where Used	Part Number
A	Special Lubricant 101	Steering cable	92-802865A1

b. Turn steering wheel until steering cable is fully extended. Lightly lubricate the exposed part of cable.

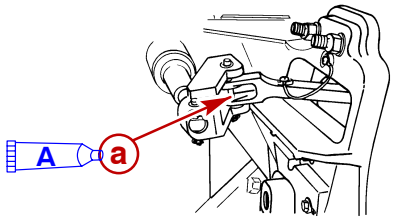


71901

a - Extended steering cable

Description		Where Used	Part Number
A	Special Lubricant 101	Steering cable	92-802865A1

c. Lubricate the steering system pivot points.



71904

a - Steering system pivot points

Description		Where Used	Part Number
A	SAE 30W Engine Oil	Steering system pivot points	Obtain locally

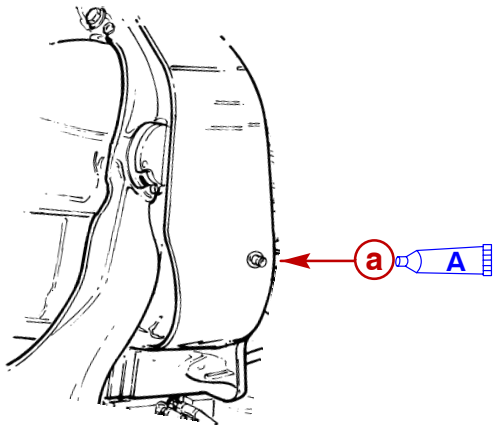
d. **On dual engine boats:** Lubricate the tie bar pivot points.

Description	Where Used	Part Number
SAE 30W Engine Oil	Tie bar pivot points	Obtain locally

e. Upon first starting engine, turn steering wheel several times to starboard and then port to ensure that the steering system operates properly before getting underway.

2. Lubricate the gimbal bearing and the sterndrive propeller shaft.

a. Lubricate gimbal bearing by applying approximately 8-10 pumps of grease from a typical hand-operated grease gun.

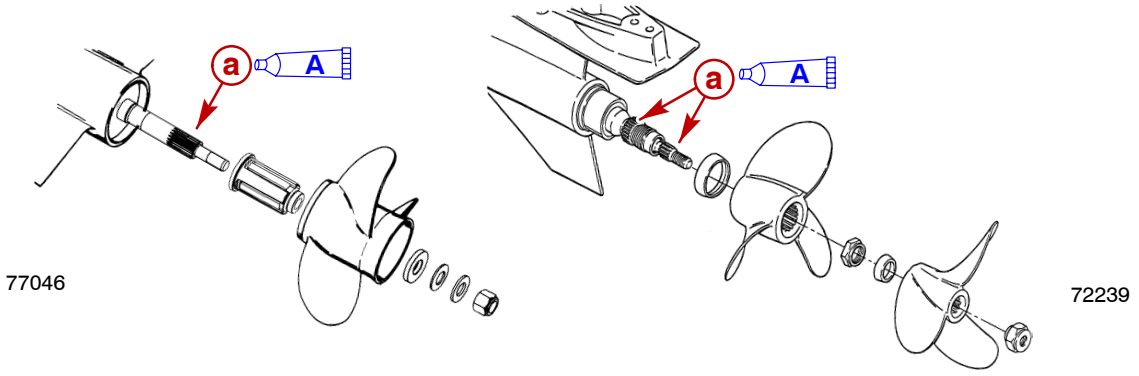


77068

a - Gimbal bearing grease fitting

Description		Where Used	Part Number
A	U-joint And Gimbal Bearing Grease	Gimbal bearing	92-802870A1

b. Apply a liberal coat of one of the following lubricants to the propeller shaft.



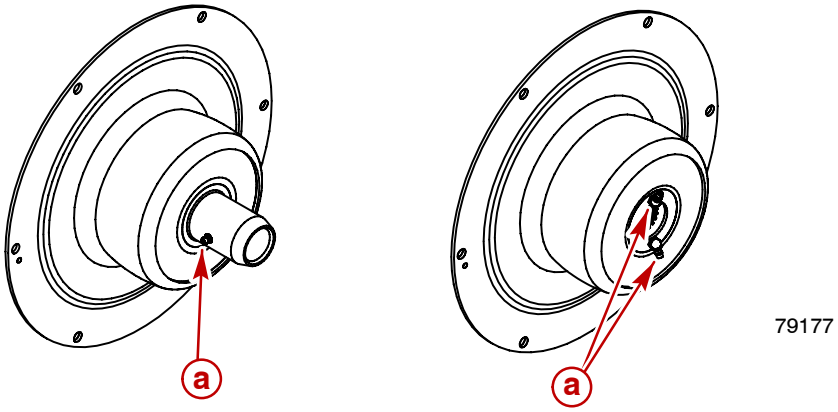
a - Propeller shaft

Description	Where Used	Part Number
Anti-Corrosion Grease	Propeller shaft	92-802867A1
Special Lubricant 101		92-802865A1
2-4-C with Teflon		92-802859A1

3. Lubricate engine coupler splines through grease fittings on coupler by applying approximately 8-10 pumps of grease from a typical hand-operated grease gun.

NOTE: *If equipped with a sealed engine coupler, the sealed coupler and shaft splines can be lubricated without removing the sterndrive unit. Apply lubricant from a typical hand-operated grease gun.*

NOTE: *If the boat is operated at idle for prolonged periods of time or if used in heavy boat applications, Bravo model aluminum coupler should be lubricated every 50 hours.*

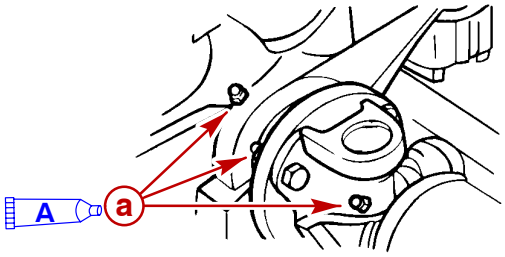


Steel Coupler **Aluminum Coupler**

a - Engine coupler grease fitting

Description	Where Used	Part Number
Engine Coupler Spline Grease	Coupler	92-802869A1

a. **Drive shaft extension models**: Lubricate the drive shaft grease fittings at transom end by applying approximately 10-12 pumps of grease from a typical hand-operated grease gun.

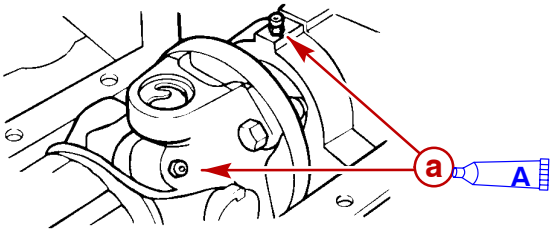


71346

a - Grease fitting locations

Description		Where Used	Part Number
A	U-joint and Gimbal Bearing Grease	Drive shaft U-joints	92-802870A1

b. Lubricate drive shaft grease fittings at engine end by applying approximately 3-4 pumps of grease from a typical hand-operated grease gun.



71347

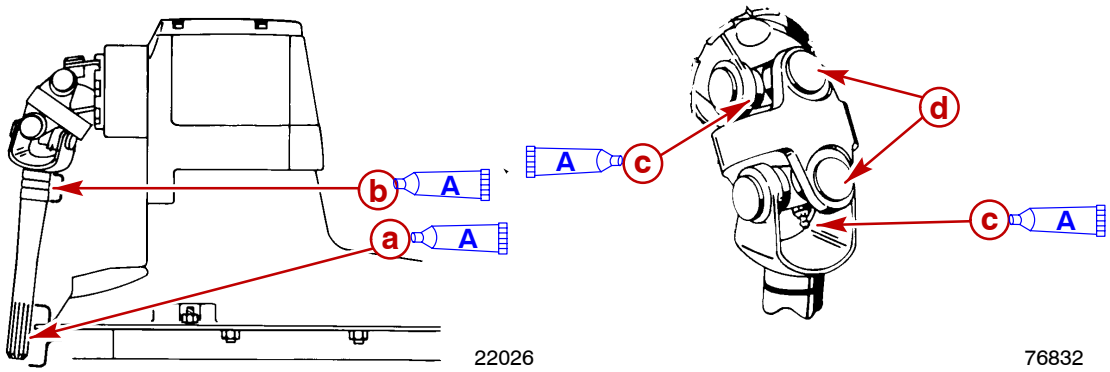
a - Grease fitting locations

Description		Where Used	Part Number
A	U-joint and Gimbal Bearing Grease	Drive shaft U-joints	92-802870A1

4. Lubricate the sterndrive U-joint cross bearings by applying approximately 3-6 pumps of grease from a typical hand-operated grease gun.

NOTE: *The crosses and bearings on the sterndrive U-joint will need to be lubricated through the grease fittings. Apply lubricant from a typical hand-operated grease gun until a small amount of grease begins to push out. The sterndrive unit must be removed to grease these fittings.*

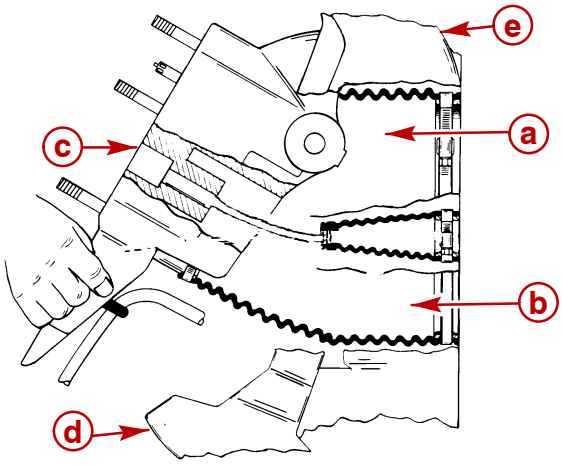
5. Lubricate the U-joint shaft splines and the O-rings.



a - U-joint shaft splines
b - U-joint shaft O-rings
c - Cross bearings grease insert
d - Cross bearings assemblies

Description		Where Used	Part Number
A	Engine Coupler Spline Grease	U-joint shaft splines and O-rings	92-802869A1
		Cross bearings grease insert	

6. Inspect U-joint bellows for cracks or other signs of deterioration. Check bellows clamps for tightness.
   a. Rotate the bell housing in the upward and side to side directions to inspect bellows and hose clamps.



a - U-joint bellow
b - Exhaust bellow
c - Bell housing
d - Gimbal ring
e - Gimbal housing

7. Check engine alignment. Refer to appropriate Mercury MerCruiser Engine Service Manual.

Power Package Recommissioning

Engine

Refer to appropriate Mercury MerCruiser Engine Service Manual.

Sterndrive

1. Perform ALL maintenance specified for completion annually in **Maintenance Chart** except items which were performed at the time of sterndrive layup.
2. Apply a thin coat of petroleum based grease to clamps and terminals to help retard corrosion.

Description	Where Used	Part Number
Liquid Neoprene	Clamps and terminals	92-25711-3

3. After recommissioning and starting engine, check steering system and shift control for proper operation.
4. Check all fluid levels before and after first use.

IMPORTANT INFORMATION

Section 1C - Troubleshooting

1 C

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Troubleshooting

This section is a guide for performance and product troubleshooting. Referrals to specific sections of this manual are made where special tests or repair procedure are to be performed.

Because of the relationship between power package components (engine and sterndrive), it will be necessary in some cases to simultaneously refer to the appropriate Mercury MerCruiser Engine Service Manual for further troubleshooting information.

Effective troubleshooting is best enhanced by:

- Personal product knowledge and experience of the trained mechanic/technician
- Allowing adequate time for testing and analysis
- Utilizing these charts as a guide, a starting point

Sterndrive Unit Will Not Slide Into Bell Housing

Cause	Special Instructions
U-joint shaft splines not aligned with engine coupler splines.	Rotate propeller shaft COUNTERCLOCKWISE to align splines.
Engine not aligned.	Check engine alignment.
Gimbal bearing not properly installed.	Check engine alignment to determine if gimbal bearing is angled or improperly installed in gimbal housing.
Damaged U-joint shaft splines and/or engine coupler splines.	Inspect and replace if necessary.

Sterndrive Unit Does Not Shift Into Gear; Remote Control Shift Handle Moves

NOTE: *For additional information on troubleshooting, refer to* ***Section 2A - Troubleshooting Shift Problems****.*

Cause	Special Instructions
Shift cables improperly adjusted.	Adjust shift cables.
Shift cables not connected.	Install and adjust shift cables.
Inner core wire broken or loose.	Reconnect or replace inner core wire.

Sterndrive Unit Does Not Shift Into Gear; Remote Control Shift Handle Does Not Move

NOTE: *For additional information on troubleshooting, refer to* ***Section 2A Troubleshooting Shift Problems.***

Cause	Special Instructions
Control box not properly assembled.	Properly reassemble control box.
Broken or damaged linkage in control box.	Repair linkage.
Controls improperly adjusted, cable end guide hitting brass barrel.	Adjust shift cables.

Sterndrive Unit Shifts Hard

NOTE: *For additional information on troubleshooting, refer to* ***Section 2A - Troubleshooting Shift Problems****.*

Cause	Special Instructions
Shift cables improperly adjusted.	Adjust shift cables.
Damaged remote control or sterndrive unit shift cable.	Replace cables and adjust.
Shift cable too short (sharp bends) or too long (loops and long bends).	Select and install proper length cable.
Corroded shift cables.	Replace, adjust and check for water leakage.
Internal wear in remote control box.	Repair as needed.
Shift cable attaching nuts too tight (end cannot pivot).	Properly install nuts.
Shift cable pivot ends are corroded or not lubricated.	Clean and lubricate.

Sterndrive Unit In Gear, Will Not Shift Out Of Gear

NOTE: *For additional information on troubleshooting, refer to* ***Section 2A - Troubleshooting Shift Problems****.*

Cause	Special Instructions
Shift cable broken.	Replace cable and adjust.
Cable end not connected in sterndrive unit.	Remove and reinstall sterndrive unit.
Remote control damaged.	Repair or replace remote control.
Internal shift mechanism damage.	Repair or replace as necessary.

Gear Housing Noise

Cause	Special Instructions
Metal particles in sterndrive unit lubricant.	Disassemble, clean and inspect and replace necessary components. (Refer to **Section 3B**, **3C**, or **3D**)
Propeller incorrectly installed.	Inspect mounting hardware. Install propeller correctly.
Propeller with untrue or out-of-balance blades.	Repair or replace, as required.
Propeller shaft bent.	Inspect and replace if necessary. (Refer to **Section 3B**, **3C**, or **3D**)
Incorrect gear shimming.	Check gear housing backlash and pinion gear height. (Refer to **Section 3B**, **3C**, or **3D**)
Worn or damaged gears and/or bearings caused by impact, overheating or improper shimming.	Disassemble, inspect and replace. (Refer to **Section 3B**, **3C**, or **3D**)

Drive Shaft Housing Noise

Cause	Special Instructions
Engine flywheel housing contacting inner transom plate or exhaust pipe.	Determine cause for interference (loose engine mounts, transom too thin, etc.) and correct as necessary.
Abnormal sterndrive operation.	Instruct operator on proper operating technique.
U-joint cross and bearing assembly retaining rings improperly installed or of incorrect size.	Ensure that proper thickness retaining rings are used and that rings are fully seated in U-joint bearing cap grooves. (Refer to **Section 3A**)
Excessive side-to-side play in U-joint cross and bearing assemblies.	Replace cross and bearing assembly.
U-joint bearing caps contacting U-joint bellows retention sleeve.	Ensure that proper cross and bearing assemblies are used. If interference is severe, replace cross and bearing assembly and / or sleeve assembly.
U-joint cross and bearings rough.	Replace assemblies. Signs of scoring, galling, or roughness are the result of lack of lubricant. (Refer to **Section 3A**)
O-rings missing or flattened out on U-joint shaft causing shaft to rattle against ID of gimbal bearing.	Install new O-rings. (Refer to **Section 3A**)

Drive Shaft Housing Noise (continued)

Cause	Special Instructions
Worn U-joint shaft splines and/or engine coupler splines.	Remove U-joint coupling end yoke and insert into gimbal bearing and engine coupling. Rotate shaft back and forth. If play is excessive, replace U-joint coupling end yoke and/or engine coupler, as necessary.
Engine alignment incorrect or engine coupler crooked.	Adjust alignment. Ensure that alignment tool moves in and out of coupler freely. After proper alignment has been obtained, check for a crooked coupler by rotating engine coupler 1/2 turn and rechecking alignment. If proper alignment is no longer observed, coupler is crooked and must be replaced. (Refer to **Section 2**)
Gimbal bearing rough.	Replace gimbal bearing. (Refer to **Section 4**) **IMPORTANT: Gimbal bearing and carrier MUST BE replaced as an assembly because they are a matched set. Failure to do this may result in a loose bearing fit in carrier.**
Loose gimbal bearing.	Reinstall bearing assembly using a new tolerance ring if carrier is loose in gimbal housing. If bearing is loose in carrier, bearing assembly must be replaced. (Refer to **Section 4**)
Gimbal bearing not fully seated in gimbal housing.	Sterndrive bearing assembly into place.
Excessive clearance between gimbal ring and gimbal housing. This could cause misalignment between bell housing and gimbal housing and also may allow gimbal ring to vibrate up and down.	Check and adjust clearance. (Refer to **Section 4**)
Improperly installed or failed rear engine mounts. This will affect engine alignment, but usually is not detectable with engine alignment tool.	Check for uneven mount height, or loose or soft mounts. Make sure there is clearance between flywheel housing and fiber washer. If no clearance exists, mounts have probably sagged. Install mounts correctly or replace, as necessary.

Drive Shaft Housing Noise (continued)

Cause	Special Instructions
Boat transom too thin. **Thickness:** 51 mm (2 in.) minimum, 57 mm (2-1/4 in.) maximum.	Add thickness to transom.
Boat transom thickness uneven. This could affect engine to transom assembly alignment and is usually not detectable with alignment tool. **Variation:** 3 mm (1/8 in.) maximum.	Repair boat as necessary.
Bell housing contacting gimbal ring. This would cause knocking in the fully trimmed IN position only.	Check for soft or split trim cylinder bushings and loose or worn hinge pin bushings. (Refer to **Section 5B**)
Stringer height uneven or transom assembly installed angled on boat transom. This will affect engine alignment, but is usually not detectable with alignment tool.	Measure the distance between the engine flywheel housing and the inner transom plate on both sides. If distances are uneven, the problem may be due to uneven stringer height or a cocked transom assembly. Adjust the stringer height or relocate the transom cutout as required.
Weak boat transom or boat bottom that flexes under power and causes engine misalignment - this condition will usually cause engine coupler failure.	This condition can sometimes be detected by having someone apply force to the top of the sterndrive unit while watching the inner transom plate. If movement can be observed, the transom is weak and must be repaired.
Rear engine mount attaching hardware improperly installed or missing.	Reinstall hardware correctly.
Engine mounting holes drilled off-center in inner transom plate engine supports or engine flywheel housing	Ensure that the holes are equally spaced fore and aft and are equal distance from the centerline.
Misalignment between bell housing, gimbal housing and engine coupler.	Contact your service center and arrange to have a technical service representative check the unit using a special gauge.

Power Shift

System Does Not React

Cause	Special Instructions
Vacuum leaks.	With engine running, check for vacuum leaks. Squirt oil on fitting and hose connections and on the shift cylinder-to-end plate joint. If oil is sucked in at any point, a vacuum leak exists. Repair leak.
Improper installation.	Reinstall.

System Binds

Cause	Special Instructions
Remote control.	Disconnect input cable at power shift cylinder. Disconnect throttle cable at carburetor or injector pump. Operate remote control. If binding occurs, find cause of binding in either cable or remote control and correct binding. If no binding occurs, check vacuum.
Slow or no shift.	Check vacuum drop-off. If vacuum drops off to “0” psi in less than 5 seconds, install repair kit.
Cable movement.	Check movement of cable from shift plate to sterndrive unit including shifting linkage movement in sterndrive unit for binding. Replace or adjust shift cable following procedures in **Section 2A**.

Performance Troubleshooting

Low WOT Engine RPM

Cause	Special Instructions
Improper sterndrive unit trim angle.	Properly adjust sterndrive unit trim angle.
Damaged propeller.	Repair or replace.
Improper propeller pitch.	Water test boat using a lower pitch propeller.
Dirty or damaged boat bottom.	Clean and/or resurface boat bottom.
Sterndrive installation too low on transom.	Contact boat manufacturer for installation specifications.
Permanent hook in boat bottom (some boats are built with a slight hook for correct boat performance).	Check for a hook in the boat bottom by placing a straight edge, at least 2 m (6 ft) long, under the bottom edge of the transom. If a hook is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

High WOT Engine RPM

Cause	Special Instructions
Propeller ventilating.	Determine cause for ventilation.
Improper propeller pitch.	Water test boat using a higher pitch propeller.
Propeller hub slipping.	Replace hub or replace propeller.
Sterndrive installation too high on transom.	Contact boat manufacturer for installation specifications.
Engine coupler hub spun.	Replace coupler.

Propeller Ventilating/Cavitating

Cause	Special Instructions
Sterndrive unit trimmed too high.	Trim sterndrive unit IN/DOWN.
Incorrect propeller.	Install correct propeller.

Poor Boat Performance And/Or Poor Maneuverability - Bow Too Low

Cause	Special Instructions
Improper sterndrive unit trim angle.	Properly adjust sterndrive unit trim angle.
Boat is bow heavy.	Redistribute boat load to stern. If bow overweight is caused by permanently installed fuel tanks, contact the boat manufacturer.
Boat is underpowered.	Check horsepower to weight ratio. Contact the boat manufacturer.
Permanent hook in boat bottom (some boats are built with a slight hook for correct boat performance).	Check for a hook in the boat bottom by placing a straight edge, at least 2 m (6 ft) long, under the bottom edge of the transom. If a hook is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

Poor Boat Performance And/Or Poor Maneuverability - Bow Too High

Cause	Special Instructions
Improper sterndrive unit trim angle.	Properly adjust sterndrive unit trim angle.
Boat is stern heavy.	Redistribute boat load to bow. If stern overweight is caused by permanently installed fuel tanks, contact the boat manufacturer.
Propeller pitch too high.	Water test the boat using a lower pitch propeller.
Permanent rocker in boat bottom (some boats are built with a slight rocker for correct boat performance).	Check for a rocker in the boat bottom by placing a straight edge, at least 2 m (6 ft) long, under bottom edge of the transom. If a rocker is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

Power Steering

Hard Steering - Helm And Cable

Cause	Special Instructions
Damaged steering cable.	Replace cable. (Refer to **Section 2**)
Steering cable too short (sharp bends) or too long (loops and long bends).	Select and install proper length cable. (Refer to **Section 2A**)
Steering cable corroded or not lubricated.	Lubricate or replace the cable.
Over-lubed cable.	Replace cable.
RideGuide™ rack or rotary head not lubricated.	Disassemble and lubricate.

Hard Steering (Engine Running) - Power Steering System

Cause	Special Instructions
Low power steering pump fluid level.	Check fluid level. (Refer to **Section 6A**)
Loose power steering pump sterndrive belt.	Adjust belt tension. (Refer to **Section 6A**)
Air in system.	Cycle to remove air. (Refer to **Section 6A**)
Fluid leak.	Locate and correct source of leak. (Refer to **Section 6A**)
If the above 4 steps do not solve the problem, test the power steering system.	Test power steering system. (Refer to **Section 6A**)

Power Steering System External Fluid Leaks

Cause	Special Instructions
Pump reservoir leaking at fill cap (reservoir too full).	Remove fluid to bring to proper level.
Pump reservoir leaking at fill cap (air or water in fluid).	Locate source of air or water and correct. Air may enter because of low reservoir fluid level or internal pump leak. Test pump. (Refer to **Section 6A**)
Loose hose connections.	Tighten hose connections.
Damaged hose.	Replace hose.
Bad cylinder piston rod seal.	Replace cylinder.
Damaged or worn control valve seals.	Replace cylinder.
Bad power steering pump seals and O-rings.	Repair pump. (Refer to **Section 6A**)
Cracked or porous metal parts.	Replace parts.

Compact Hydraulic Steering

Important Information

Whenever a troubleshooting solution calls for removal from vessel and/or dismantling of steering system components, such work must be carried out by a qualified marine mechanic. The following is offered as a guide only and neither Mercury MerCruiser nor the helm manufacturer are responsible for any consequences resulting from incorrect repairs.

Most faults occur when the installation instructions are not followed and usually show up immediately upon filling the system. The most common faults encountered and their likely cause and solution are provided in the following.

Sometimes when returning the steering wheel from a locked position, a slight resistance may be felt and a clicking noise may be heard. This should not be mistaken as a fault, as it is a completely normal situation caused by the releasing of the lock spool in the system.

⚠ WARNING

Avoid serious injury or death due to FIRE or EXPLOSION. Ensure that engine compartment is well-ventilated and that no gasoline vapors are present to prevent the possibility of a FIRE or EXPLOSION.

Helm Becomes Jammed During Filling

Cause	Special Instructions
Blockage in the line between the helms and the cylinders.	Ensure that hoses were not kinked or pinched during installation. If so, the hose must be removed and replaced.

System Difficult To Fill

Cause	Special Instructions
Air in system.	Review filling instructions.

Steering Hard To Turn

Cause	Special Instructions
Steering cylinder pivot bushings are too tight or trunion is bent, causing mechanical binding.	To test, disconnect clevis from steering lever and turn the steering wheel. If it now turns easy, correct cause of mechanical binding. Please note that excessively loose connections to steering cylinder or steering lever can also cause mechanical binding.
Restrictions in hoses.	Find restrictions and correct.
Air in hydraulic fluid.	Refer to filling and purging instructions.
Wrong hydraulic fluid has been used to fill steering system.	Drain system and fill with approved hydraulic fluid.

Helm Unit Bumpy - Requires Too Many Turns

Cause	Special Instructions
Dirt in inlet check of helm pump.	Replace helm unit.

Power Trim Electrical System

NOTE: *The numbers in quotation marks, e.g. "3", refer to the Power Trim System Wiring Diagram.*

Power Trim Pump Motor Will Not Operate In The OUT/UP Or IN/DOWN Direction - Solenoids Do Not Click

Cause	Special Instructions
Bad electrical connection at the 110 amp fuse or the battery, or the harness came unplugged from the pump	Check all electrical connection points.
20 amp fuse blown.	Determine cause for the blown fuse and correct. Then replace fuse. ***NOTE:*** *If fuse blows while trimming OUT/UP or raising sterndrive unit, problem may be due to grounded trim limit switch leads. To check for grounded condition, disconnect trim limit switch leads at bullet connector "**14**," "**15**," "**16**," and "**17**." If sterndrive unit can now be raised (using Trailer switch), trim limit switch or leads are grounded.*
Power trim pump battery cables or wiring harness connections corroded or loose.	Clean and/or tighten connections "**1**," "**2**," "**4**," "**10**," "**11**," "**12**" and "**18**" as necessary.
Trim control wiring harness connector loose or corroded.	Clean and secure connection "**13**" as necessary.
110 amp fuse blown (does not apply to intermittent problem).	Check for voltage at terminal "**4**." If no voltage indicated, determine cause of blown fuse.
Open circuit in trim control wiring harness.	Check for battery voltage at terminal "**8**" while trimming OUT/UP and at terminal "**6**" while trimming OUT/UP. If no voltage is indicated, check trim control for a loose or corroded connection or a damaged power supply lead in harness.
Thermal circuit breaker in pump motor open.	Replace commutator end plate assembly.

Power Trim Pump Motor Will Not Operate In The OUT/UP Or IN/DOWN Direction - Both Solenoids Click

Cause	Special Instructions
Faulty solenoids or loose or corroded connections.	Check for battery voltage at terminals "5" while trimming OUT/UP. If no voltage is indicated, check connections "2," "3," "4" and "5" and/or replace solenoids.
Pump motor brushes stuck, corroded or worn out.	Clean or replace as required.
Armature commutator dirty.	Clean or replace armature as required.
Armature faulty.	Test for shorted, open or grounded condition and replace if needed.
Field and frame faulty.	Check for open or grounded condition. Replace field and frame assembly if needed.
Water or oil in motor.	Replace motor assembly.
Pump gears frozen.	Replace pump valve body and gear assembly.
Power trim pump harness or trim control harness shorted between OUT/UP and IN/DOWN circuit (pump trying to operate in OUT/UP and IN/DOWN direction simultaneously).	Disconnect BLU/WHI lead from solenoid terminal "8." If pump motor will now operate in the OUT/UP direction, a short in the harness exists. Repair or replace harness as needed.

Power Trim Pump Motor Operates In The OUT/UP Direction, But Not In The IN/DOWN Direction - IN/DOWN Solenoid Does Not Click

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections "6" and "7" and clean and/or tighten as required.
Open IN/DOWN circuit in trim control or pump wiring harness.	Check for battery voltage at terminal "6" while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or a faulty OUT/UP trim switch. Repair or replace as required.
Solenoid faulty.	Replace solenoid.

Power Trim Pump Motor Operates In The OUT/UP Direction, But Not In The IN/DOWN Direction - IN/DOWN Solenoid Clicks

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections "4" and "5." Clean and/or tighten as necessary.
Faulty solenoid.	Check for battery voltage at terminal "5" while trimming IN/DOWN. If no voltage is indicated, replace solenoid.
Faulty IN/DOWN field winding.	Replace field and frame assembly.

Power Trim Pump Motor Operates In The IN/DOWN Direction, But Not In The OUT/UP Direction - Both Trim And Trailer Switches Inoperative - OUT/UP Solenoid Does Not Click

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections "8" and "9." Clean and/or tighten as necessary.
Open OUT/UP circuit trim control or pump wiring harness.	Check for battery voltage at terminal "8" while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, blown fuse (if trim control is equipped), damaged OUT/UP circuit lead or a faulty OUT/UP trim switch. Repair or replace as necessary.
Faulty solenoid.	Replace solenoid.

Power Trim Pump Motor Operates In The IN/DOWN Direction, But Not In The OUT/UP Direction - Both Trim And Trailer Switches Inoperative - OUT/UP Solenoid Clicks

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections "2" and "3." Clean and/or tighten as necessary.
Faulty solenoid.	Check for battery voltage at terminal "3" while trimming OUT/UP. If no voltage is indicated, replace solenoid.
Faulty OUT/UP field winding.	Replace solenoid.

Trim Control OUT/UP Trim Switch Inoperative - Trailer Switch Operates

Cause	Special Instructions
Trim limit switch lead bullet connectors loose or corroded.	Clean and/or tighten connections "14," "15," "16" and "17" as necessary.
Faulty trim limit switch or leads.	Disconnect trim limit switch leads from trim harness. Connect a continuity meter between leads "16" and "17." Continuity should be indicated with sterndrive unit in full IN/DOWN position. If not, check for damaged leads or poor connections. If this is not the cause, replace trim limit switch.
Open trim control OUT/UP circuit.	Check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or faulty OUT/UP trim switch. Repair or replace as necessary.

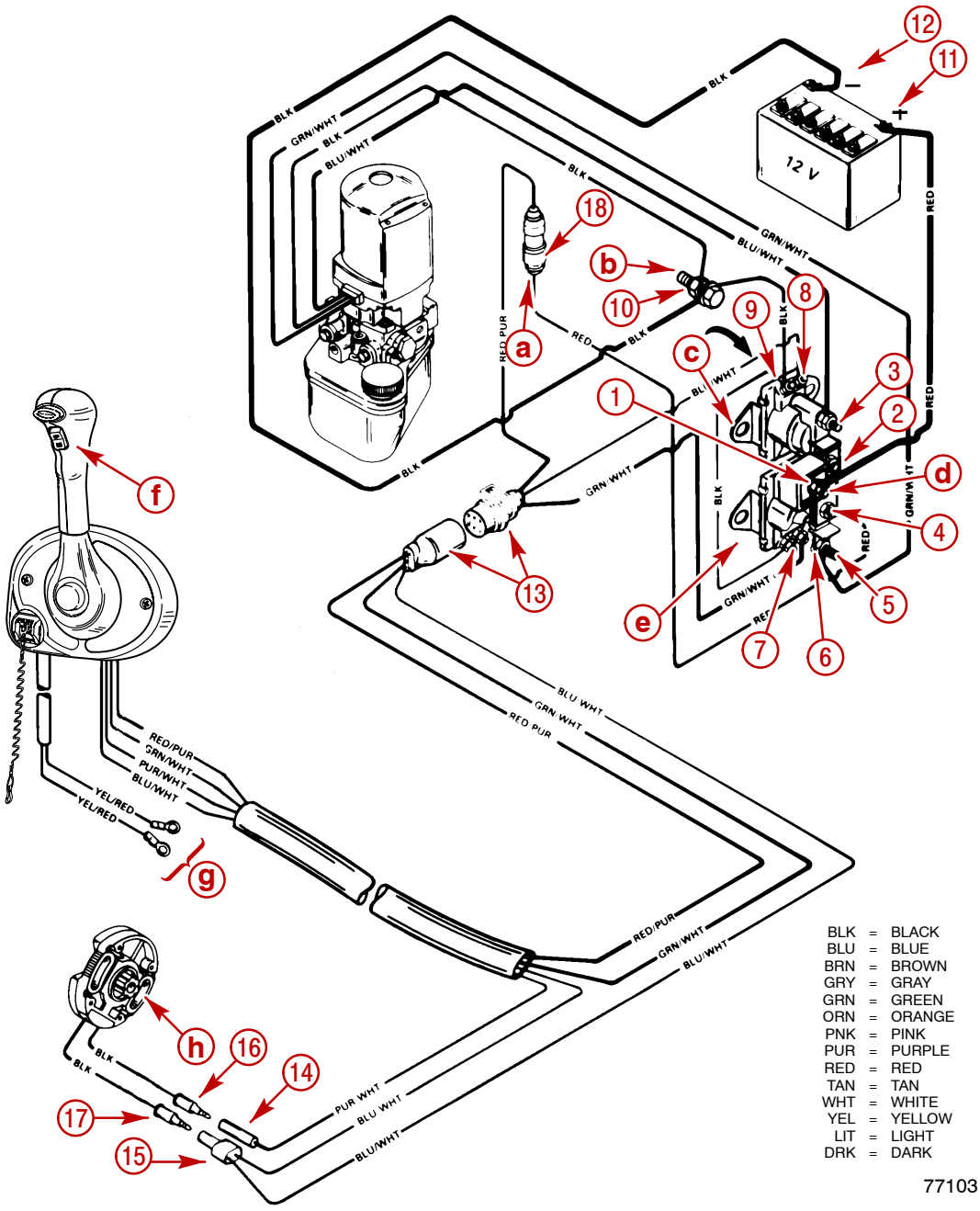
Trim Control Trailer Switch Inoperative - Trim OUT/UP Switch Functions

Cause	Special Instructions
Open trim control trailer circuit.	Check for a faulty trailer switch, loose or corroded connections or damaged trailer circuit lead.

Trim System Functions While Unattended

Cause	Special Instructions
Faulty trim or trailer switch.	Replace switch.
Shorted trim pump harness or trim control harness.	Repair or replace as required.

Power Trim System Wiring Diagram



NOTE: *Numbered callouts refer to connections referenced in the Power Trim Electrical System troubleshooting charts.*

- **a** - 20 amp. fuse
- **b** - Ground bolt (floor mount)
- **c** - UP solenoid
- **d** - 110 amp. fuse
- **e** - DOWN solenoid
- **f** - Trim/Trailer switch
- **g** - Neutral switch to instrument wiring harness
- **h** - Trim limit switch

Power Trim Hydraulic System

NOTE: *The numbers in quotation marks, e.g. "3," refer to the Power Trim Hydraulic Schematic.*

Sterndrive Unit Cannot Be Trimmed OUT/UP, Trims Slowly Or With Jerky Movements

Cause	Special Instructions
Power trim pump oil level low.	Check for cause of low oil level and correct. Add oil and bleed trim system.
Air in trim system.	Check for cause of entry and correct. Add oil to pump and bleed air from system.
O-rings damaged on Manual Release Valve (if equipped) or valve not completely closed.	Replace valve and/or close completely.
Insufficient pump pressure or pump shuttle valve stuck.	Test. If shuttle **1** is stuck, replace pump adapter (Refer to **Section 5A**). If pressure is low, replace adapter or attempt to repair by replacing the following components: ● OUT/UP Pressure Relief Valve ● Thermal Relief Valve
Hoses reversed on 1 cylinder only.	Connect hoses **7** and **8** correctly.
Trim cylinders binding.	Check for cause of binding (bent piston rod, scored cylinder). Repair or replace as necessary.
Gimbal housing-to-trim pump hydraulic hose pinched.	Replace hose **7**.
Up pressure relief valve has dirt particles under check ball.	Replace with a new valve kit.

Sterndrive Unit Will Not Stay In Trimmed OUT/UP Position

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed system.
Shuttle valve (poppet valve).	Check for dirt. Install new poppet valve.

Sterndrive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse - Unit Thumps When Shifting

Cause	Special Instructions
Trim pump IN/DOWN circuit leaking internally.	Test according to appropriate service manual. Replace adapter or attempt to repair by replacing the pilot check valves or seals. (Install Trim Pump Rebuild Kit)

Oil Foams Out Of Pump Fill/Vent Screw

Cause	Special Instructions
Contaminated oil.	Flush system with clean oil refill pump and bleed trim system.
Oil level low.	Check for cause of low oil level and correct. Add oil to pump and bleed system.

Sterndrive Unit Cannot Be Lowered From UP Position Or Lowers With Jerky Movements

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed trim system.
Low oil level.	Add oil.
Insufficient IN/DOWN pressure or shuttle valve stuck.	Test. If shuttle **1** is stuck, replace pump adapter. (Refer to **Section 5A**) If pressure is low, replace adapter or attempt to repair by replacing the following items: ● IN/DOWN pressure relief valve **1**.
Trim cylinders binding.	Check for cause of binding. Repair or replace as necessary.
Gimbal housing-to-trim pump hydraulic hose pinched.	Replace IN/DOWN hose **8**.
Hoses reversed on 1 trim cylinder only.	Reconnect hoses correctly.
Sterndrive unit binding in gimbal ring.	Check for cause of binding and replace.
Down pressure relief valve (6) has dirt particles under check ball.	Replace with a new valve kit.

Sterndrive Unit Will Not Stay In Full UP Position For Extended Periods

Cause	Special Instructions
External leakage.	Check for cause and correct. Add oil to pump and bleed trim system.
Pump OUT/UP circuit leaking internally.	Test. (Refer to **Section 5A**) Replace adapter **2** or attempt to repair by replacing the following: ● Thermal relief valve **4**. ● Poppet valves seals **9**.
Trim cylinder(s) leaking internally and pump DOWN circuit leaking internally (both must be faulty to cause this problem).	Rebuild cylinders **5** Repair or replace adapter **2** as necessary.

Sterndrive Will Not Stay In The Trimmed OUT/UP Position When Underway

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed system.
Leaky poppet valve.	Install repair kit for poppet valve **1**.

Sterndrive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse - Unit Thumps When Shifting

Cause	Special Instructions
Trim cylinders leaking internally.	Test. (Refer to **Section 5A**) Rebuild or replace cylinders as necessary.
Trim pump IN/DOWN circuit leaking internally.	Test. (Refer to **Section 5A**) Replace adapter or attempt to repair by replacing the following: ● Pilot check valves or seals **9**. ● Install trim pump rebuild kit

Trim Motor Operates But Does Not Pump Oil

Cause	Special Instructions
Broken coupler between the pump and the motor.	Replace the coupler.
Plugged pick-up screens.	Replace pick-up screens.

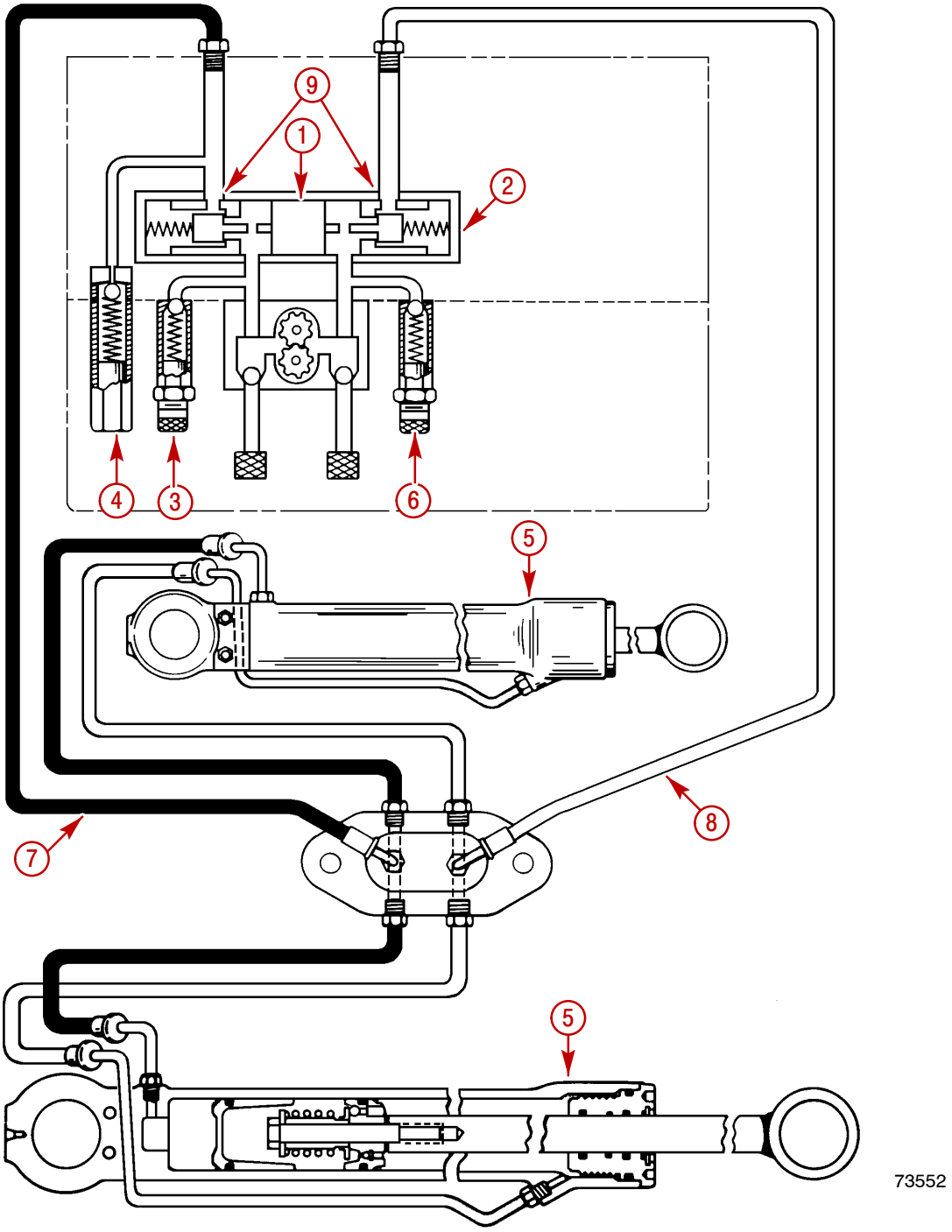
Trim Pump Operates Slowly In Both Directions

Cause	Special Instructions
Check the condition of the oil; it may be contaminated and thick like honey.	Remove the reservoir and clean out the contaminated oil.

Trim Pump Operates Slowly With A Laboring Sound

Cause	Special Instructions
A possible tight adapter pump gear or water or oil in the motor.	Replace the pump assembly in the adapter or replace the electric motor assembly.

Power Trim Hydraulic Schematic



1 - Shuttle	6 - IN/DOWN pressure relief valve
2 - Pump adapter	7 - UP/OUT hose
3 - UP/OUT pressure relief valve	8 - IN/DOWN hose
4 - Thermal relief valve	9 - Poppet valves
5 - Trim cylinder	

Corrosion Protection

NOTE: *The numbers in quotation marks, e.g. "3," refer to the MerCathode Controller Wiring Diagram.*

Corrosion On Underwater Parts, Without MerCathode Or Impressed Current Protection

Cause	Special Instructions
Sacrificial anodes consumed.	Replace anodes when 50% consumed.
Stainless steel propeller installed.	Add MerCathode (impressed current protection) or additional sacrificial anodes.
Sacrificial anodes not grounded to sterndrive.	Remove anodes, clean contact surface, reinstall and check continuity.
Loss of continuity between underwater parts and ground.	Provide good ground connections.
Shore power causing overload of anode(s) and/or MerCathode.	Disconnect shore power or install Quicksilver isolator.
Paint on sterndrive heavily worn (exposing more metal).	Prime and repaint and/or install additional anodes.
Sacrificial anodes painted.	Remove paint or replace anodes.
Sterndrive tilted so far that anodes are out of the water.	Leave sterndrive down, install additional anode (below waterline) or transom mount a MerCathode.
Only power trim cylinders are corroded.	Provide good ground to sterndrive. All parts must be grounded.
Corrosion in area of exhaust outlets. Exhaust deposits can cause corrosion.	Remove deposits with marine or auto wax.
Corrosion occurring after unit removed from saltwater.	Wash exterior and flush interior with fresh water.
Corrosion and/or salt build-up between mating parts.	Exclude moisture from between mating parts with 2-4-C with Teflon.
Stainless Steel parts corroding: Tightly wrapped fishing line or foreign material excludes oxygen, causing corrosion. Iron particles, such as from a wire brush, cause rusting. Propeller pitting can occur if electrical continuity is lost.	Clean parts, remove foreign material, ensure continuity.

Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection - Sterndrive Unit Corroding

Cause	Special Instructions
Poor connection between reference electrode (BRN) lead or anode (ORN) lead and MerCathode controller.	Clean and/or tighten connection. Repair wiring.
Faulty MerCathode reference electrode.	Disconnect reference electrode lead (BRN) from the controller “R” terminal. Connect the lead to positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect negative (–) meter lead to negative (–) battery terminal. Note meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the sterndrive. The same reading should be obtained in both cases. If not, replace the reference electrode.
Faulty MerCathode controller.	With anode and reference electrode leads connected to controller, connect a jumper wire between “R” and negative(–) terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to “A” terminal on controller. Connect the negative (–) meter lead to the negative (–) controller terminal. Reading should be as follows: ● Freshwater Areas = 11.5 volts minimum. ● Seawater Areas = 3.55 volts minimum If the reading is low, replace the controller.
Too much cathode (such as stainless steel).	MerCathode system overpowered by large quantity of stainless steel below the waterline.
Loss of continuity between sterndrive components and ground.	Ensure continuity (check continuity wires and washers).
Sacrificial anodes consumed, painted or inoperative.	Replace anodes.
MerCathode reference electrode or anode painted.	Remove paint or replace anode or MerCathode reference electrode.

Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection - Sterndrive Unit Corroding (continued)

Cause	Special Instructions
No power to MerCathode controller.	Connect positive (+) lead of volt meter (set on 0-20 volt scale) to positive (+) terminal on the controller and negative (-) volt meter lead to negative (-) terminal. Meter should indicate battery voltage. Check for blown fuse (if equipped) on a standard MerCathode system. Clean the connection or repair wiring as required.
MerCathode system not functioning	Check the fuse in the hot lead.
	Check battery.
	Check for loose connections at controller and battery
	Check the grounding wire between the sterndrive and the controller.

Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection - Sterndrive Unit Over-protected

STERNDRIVE OVER-PROTECTED

Cause	Special Instructions
Faulty MerCathode reference electrode.	Disconnect reference electrode lead (BRN) from “R” terminal on controller. Connect the lead to the positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the sterndrive. The same reading should be obtained in both cases. If not, replace the reference electrode.
Faulty MerCathode controller.	Check controller output. If the hull potential indicates overprotection, remove the reference electrode lead from the controller. If the controller is off (no impressed current called for) the voltage between the negative (BLK) and the anode should be less than 1 volt. Measure amperage; with the reference electrode disconnected, the amperage between the negative on the controller and the anode terminal should be less than 1 milli-amp. Replace the controller if needed.
Stray current corrosion (electrical current leaves a metal conductor and creates a path through the water).	Disconnect electrical components 1 at a time and observe the multi-meter reading until you eliminate the high reading. Correct the source of the stray current.
Poor connection between the MerCathode reference electrode lead (BRN) and the “R” terminal on the controller.	Clean and/or tighten the connection. Repair wiring as needed.
MerCathode system not functioning.	Check the fuse in the hot lead.
	Check the battery.
	Check for loose connections at controller and battery.
	Check the grounding wire between the sterndrive and the controller.

Testing Procedure for Corrosion Protection

1. Unplug shore power (if equipped).
2. Measure hull potential with silver/silver chloride reference electrode and digital volt/ohm meter.
3. The following readings indicate the corrosion protection status of the sterndrive unit.

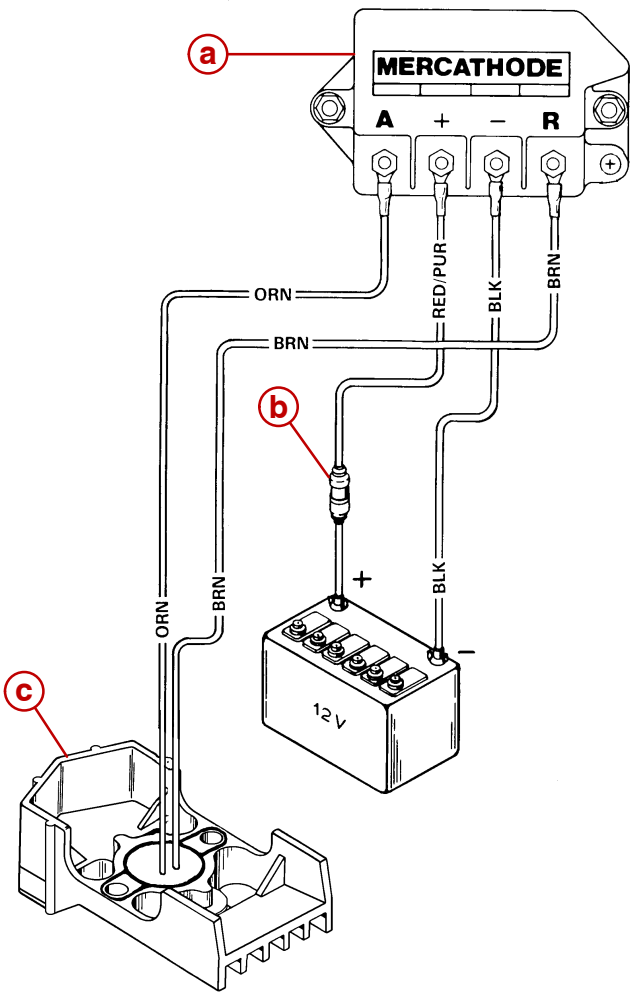
	Digital Multi-Meter	Corrosion Protection
Freshwater	Between 750 - 1050 millivolts	Sterndrive is protected
	Below 750 millivolts	Sterndrive is corroding
	Above 1050 millivolts	Sterndrive is overprotected

	Digital Multi-Meter	Corrosion Protection
Salt, Polluted or Mineral Laden Water	Between 850 - 1100 millivolts	Sterndrive is protected
	Below 850 millivolts	Sterndrive is corroding
	Above 1100 millivolts	Sterndrive is overprotected

CORROSION SYMPTOMS

- Paint blistering (usually on sharp edges)
- Loosely adhering white corrosion products on exposed aluminum surfaces (do not confuse these with tenaciously clinging calcium carbonate deposits)
- Aluminum pitting

MerCathode Controller



BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT= White
YEL = Yellow
LIT = Light
DRK = Dark

73596

Standard model shown, quick connect similar

- **a** - Controller (Blue)
- **b** - 20 amp. fuse
- **c** - Electrode

Description	Nm	lb-in.	lb-ft
MerCathode mounting screws	3-4	24-33	

The MerCathode controller assembly is located on the back of the front lifting eye.

1. Connect wires to MerCathode controller assembly and MerCathode quick connect. Apply a thin coat of Liquid Neoprene to all connections.

IMPORTANT: Opposite end of RED/PURPLE wire must be connected directly to battery positive (+) terminal. Do not connect it to a switched positive (+) circuit. MerCathode system must function continuously for proper corrosion protection.

Description		Where Used	Part Number
A	Liquid Neoprene	MerCathode connections	92-25711-3

NOTES:

REMOVAL, INSTALLATION, AND ADJUSTMENTS

Section 2A - All Models

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2 A

Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

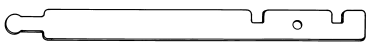
Description	Nm	lb-in.	lb-ft
Transom assembly attaching bolts and nuts	34		25
Water inlet fitting bolts	5	45	
Exhaust pipe to gimbal housing bolts	34		25
Block off plate to gimbal housing bolts	34		25
Power trim hydraulic hose fittings	9	80	
Steering system pivot bolts	34		25
Coupler nut	47		35
Power steering hydraulic hose fittings	34		25
Sterndrive unit to bell housing attaching nuts	68		50

[1] *Amount specified is MINIMUM.*

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
Perfect Seal	Water bypass fitting	92-34227-1
Special Lubricant 101	Steering system bushings	92-802865A1
	Steering system pivot bolts	92-802865A1
	Sterndrive shift linkage assembly	
	Clevis pins	
	Steering cable	
Liquid Neoprene	All electrical connections	92-25711-3
Engine Coupler Spline Grease	U-joint shaft splines and O-rings	92-802869A1
High Performance Gear Lube	O-ring seals	92-802854A1
SAE 30W Engine Oil	Shift cable pivot points	Obtain locally
2-4-C with Teflon	Shift cable end	92-802859A1
	Bell housing studs	

Special Tools

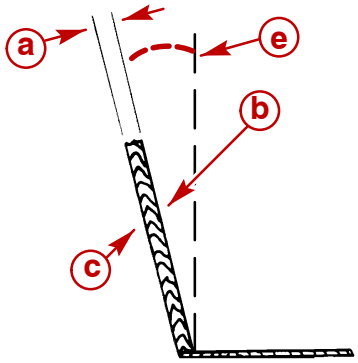
Shift Cable Adjustment Tool		
 73479	Attaches over the shift cable. Use for proper Bravo sterndrive unit shift cable adjustment at the shift plate.	91-12427

Transom Thickness and Surface

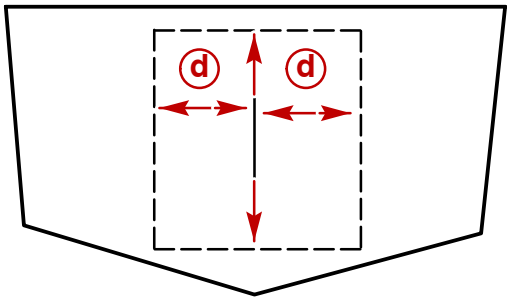
IMPORTANT: Transom thickness and surface plane (flatness) must be controlled where the sterndrive unit mounts.

Transom thickness and surface must conform to the following:

Transom Specifications	
Thickness	Between 51 - 57 mm (2 - 2-1/4 in.)
Parallelism	Inner and outer surfaces must be parallel within 3 mm (1/8 in.)
Flatness	Transom surfaces in area where transom assembly will be mounted (includes vertical as well as horizontal dimensions): Inner Surface - Flat within 3 mm (1/8 in.) Outer Surface - Flat within 2 mm (1/16 in.)
Angle	10 - 16 Degrees

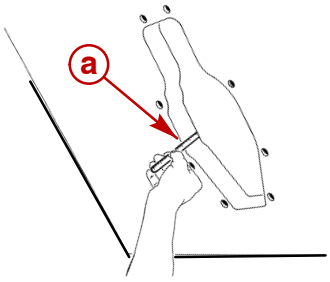


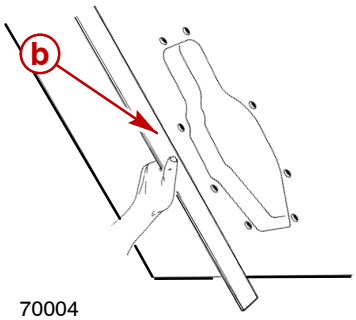
22170



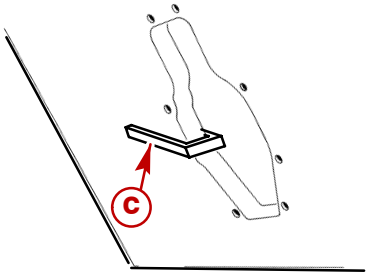
72700

a - Transom thickness
b - Inner surface
c - Outer surface
d - Transom plate coverage
e - Transom angle





70004



75479

a - Measuring thickness
b - Measuring surface flatness
c - Suitable mandrel to check for uniform transom thickness

Special Information

Bravo Three Notice: Trim-In Limit Insert

NOTE: *Bravo One, Two, and Three Models are equipped with a Trim-In Limit Insert.*

It has been brought to our attention that some boats (predominantly deep-Vee heavy boats) will roll up on their side under certain, specific, operating conditions. The roll can be either to port or starboard and may be experienced while moving straight ahead, or while making a turn. The roll occurs most frequently at or near maximum speed, with the sterndrive unit trimmed at or near full trim-in. While the boat will not roll completely over, the roll may be sufficient to unseat the operator or passengers, and thereby create an unsafe situation.

The roll is caused by stern-lift created from excessive sterndrive unit trim-in. Under these extreme stern-lift / bow-down conditions instability can be created, which may cause the boat to roll. Weight distribution to the stern can reduce stern-lift and, in some circumstances, help to control the condition. Weight distribution in the bow, port or starboard, may worsen the condition.

The Trim-In Limit Insert reduces stern-lift by preventing the sterndrive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, it may not eliminate the tendency entirely. The need for this Trim-In Limit Insert, and its effectiveness, can only be determined through boat testing and is ultimately the responsibility of the boat manufacturer.

⚠ WARNING

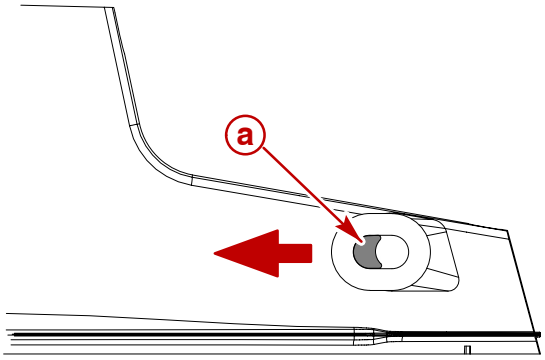
It is recommended that only qualified personnel adjust the Trim-In Limit Insert. Boat must be water tested after adjusting the device to ensure that the modified trim-in range does not cause the boat to exhibit an undesirable boat handling characteristic if the sterndrive unit is trimmed In at higher speeds. Increased trim-in range may cause handling problems on some boats which could result in personal injury.

All Models

IMPORTANT: The trim-in limit insert must be properly positioned before installing the trim cylinder anchor pin.

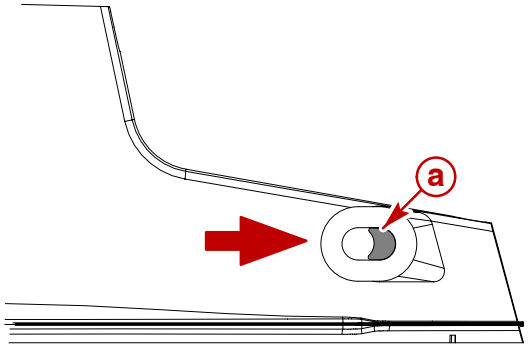
NOTE: *When removing the sterndrive unit, make a note of the position of the insert for reference when reinstalling the sterndrive unit.*

1. Ensure that the trim-in limit insert is positioned as shown for the appropriate Bravo model.



75157

Bravo One and Two (positioned forward)



75158

Bravo Three (positioned aft)

a - Trim-in limit insert

IMPORTANT: The position of the trim-in limit insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

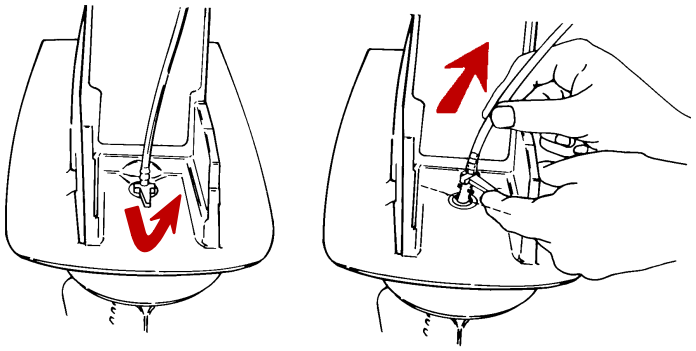
Sterndrive Unit Removal

1. Shift remote control into NEUTRAL.
2. Place the sterndrive unit to the full UP/OUT position.

⚠ CAUTION

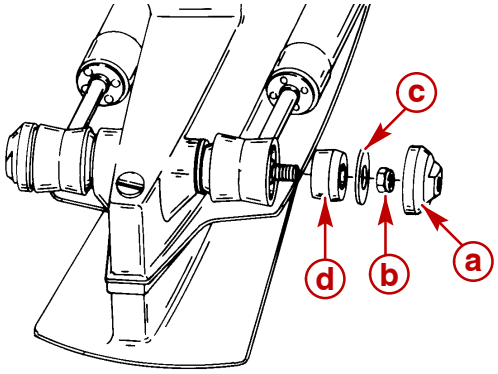
Avoid speedometer hose fitting damage. Disconnect the speedometer hose fitting from the sterndrive shaft housing before removing the sterndrive unit.

3. Disconnect the speedometer hose fitting from the sterndrive shaft housing.



22025

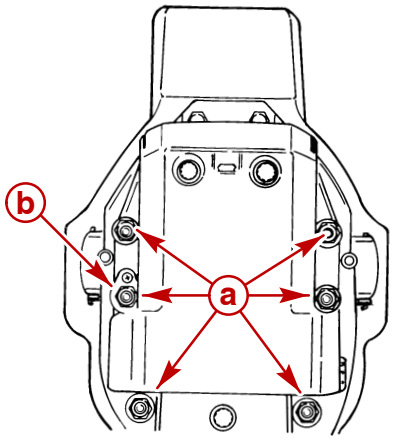
4. Place the sterndrive unit to the full DOWN/IN position and remove the power trim cylinder from the aft end of the sterndrive shaft housing.



22029

a - End cap
b - Nut
c - Flat washer
d - Bushing

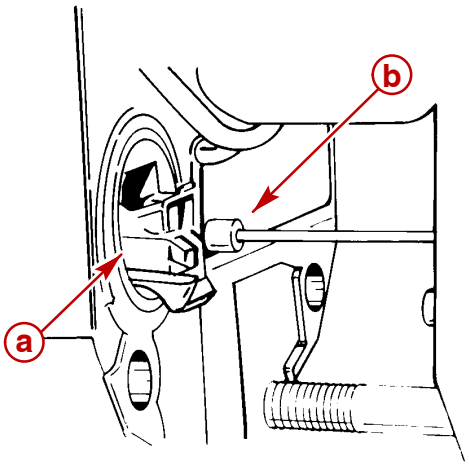
5. Remove the locknuts holding the sterndrive onto the bell housing and then remove the sterndrive unit.



22031

a - Locknuts (6) and flat washers (5)
b - Ground plate (flat washer not used here)

6. Ensure that the shift cable linkage jaws open and release the shift cable end.

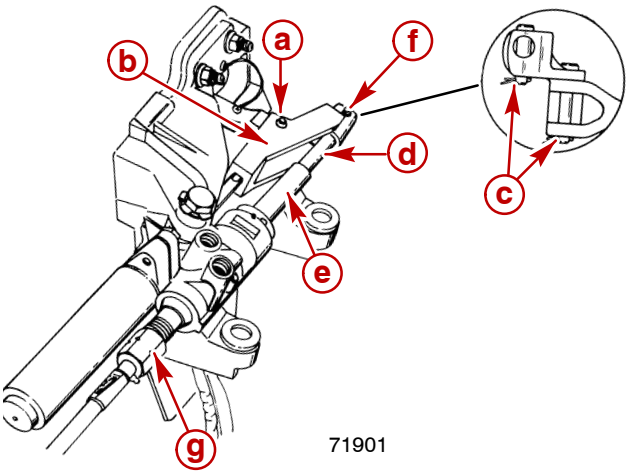


22025

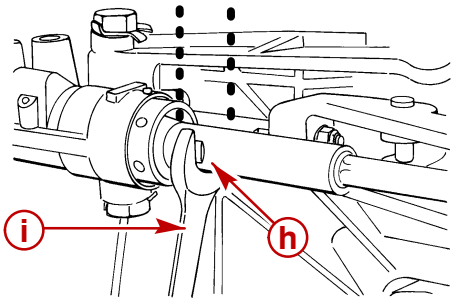
a - Shift linkage jaws
b - Shift cable end

Transom Assembly Removal

1. Remove engine. Refer to the appropriate Mercury MerCruiser Engine Service Manual.
2. Completely disconnect the power steering assembly.
   a. Disconnect the rear clevis pin from the steering lever.
   b. Disconnect forward clevis pin from steering cable end.
   c. Holds flats on cable guide in vertical position with suitable wrench. Loosen coupler nut and remove steering cable.



71901

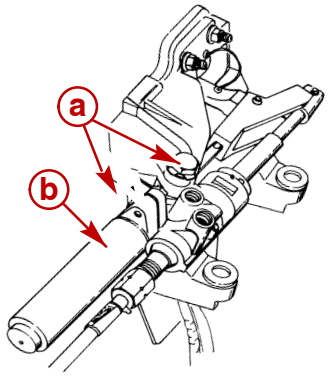


73901

Control valve

- **a** - Rear clevis pin
- **b** - Steering lever
- **c** - Cotter pins
- **d** - Steering cable end
- **e** - Cable guide
- **f** - Forward clevis pin
- **g** - Coupler nut
- **h** - Flats
- **i** - Suitable wrench

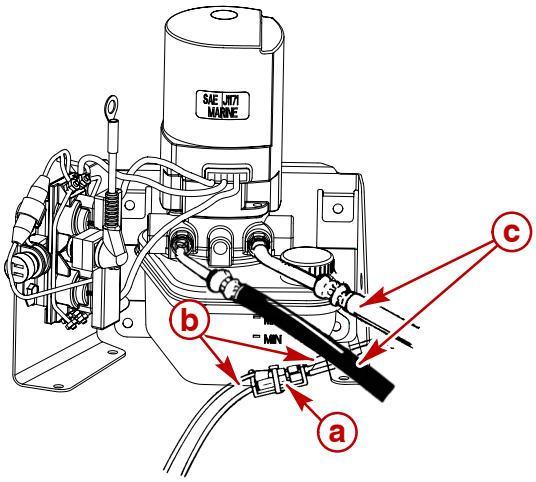
   d. Bend tab washer tabs down and away from pivot bolt heads.
   e. Remove the pivot bolts.
   f. Remove the power steering control valve.



71901

- **a** - Pivot bolts
- **b** - Control valve

3. Disconnect trim limit switch wires.
4. Remove power trim pump hydraulic hoses and disconnect trim limit switch wires. Cap hoses and plug pump fitting holes.

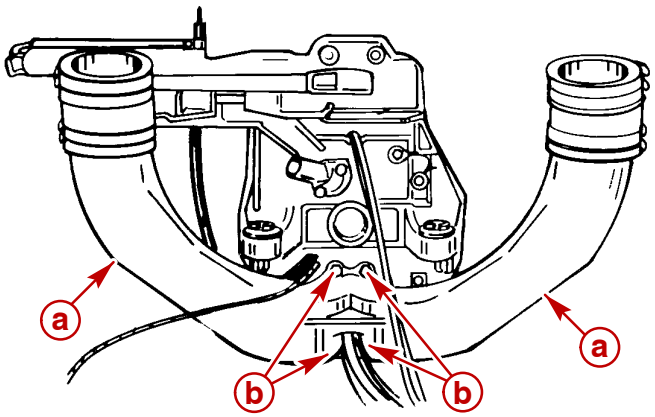


76631

a - Tie strap
b - Trim limit switch wires
c - Hydraulic hoses

5. Remove exhaust pipe.

NOTE: For through transom exhaust, it is not necessary to remove the block-off plate unless the gasket/mating surface is leaking or the exhaust system is to be modified.

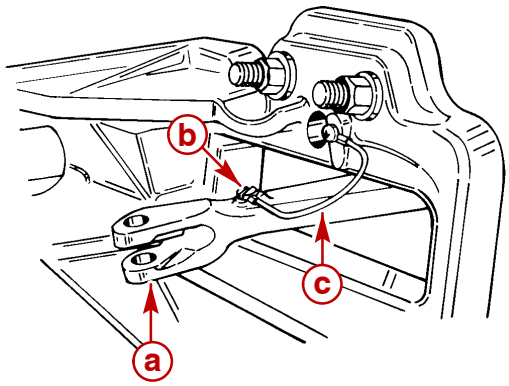


22028

Standard through prop exhaust shown.

a - Exhaust pipe
b - Bolts (4)

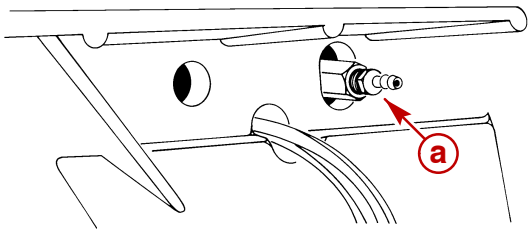
6. Remove the continuity wire from the steering lever.



22028

a - Steering lever
b - Screw
c - Continuity wire

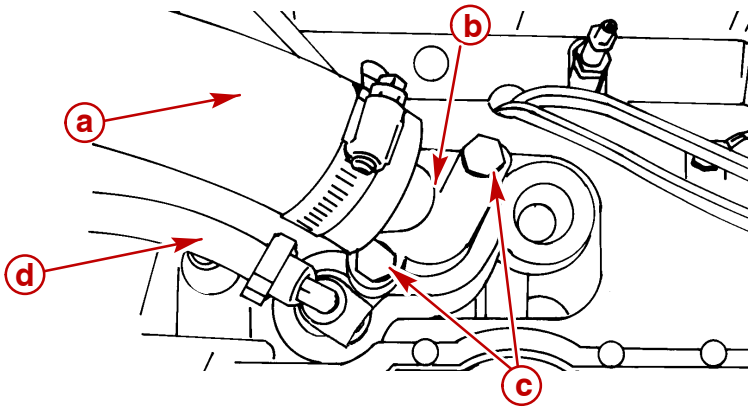
7. Disconnect the speedometer hoses.



70015

a - Speedometer fitting

8. Remove seawater inlet hose.

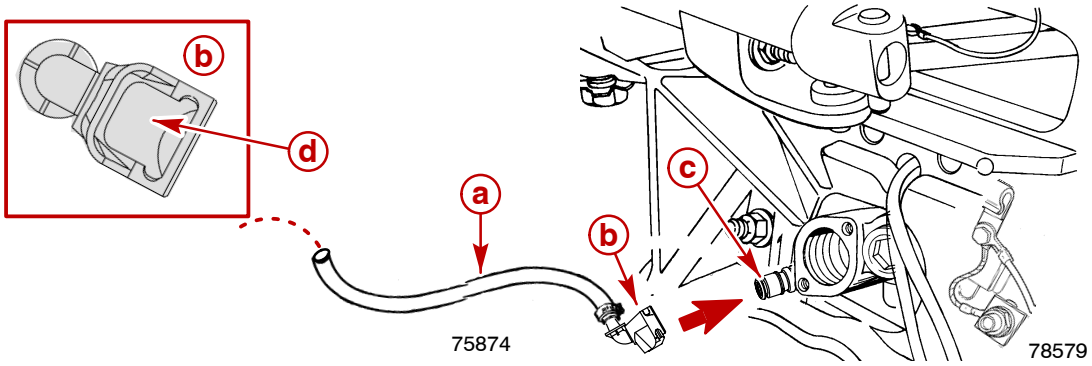


76636

a - Seawater inlet hose
b - Seawater pickup outlet
c - Bolts and star washers
d - Gear lube monitor hose

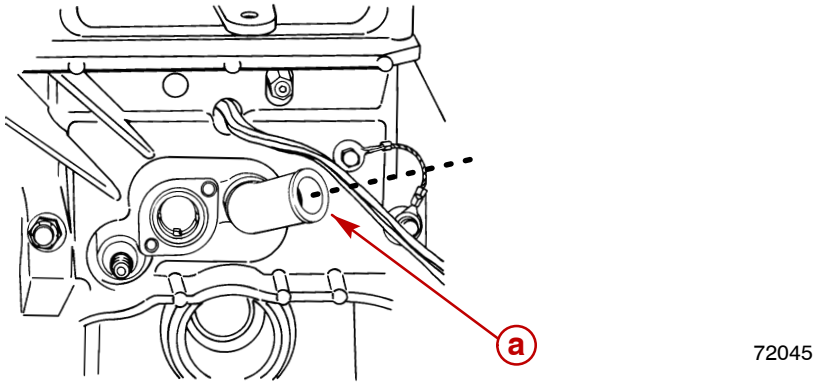
9. Remove seawater pickup outlet.
10. Remove gear lube monitor hose.

NOTE: *Models not equipped with the quick release fitting use a gear lube monitor hose with a threaded brass fitting to the gimbal housing.*



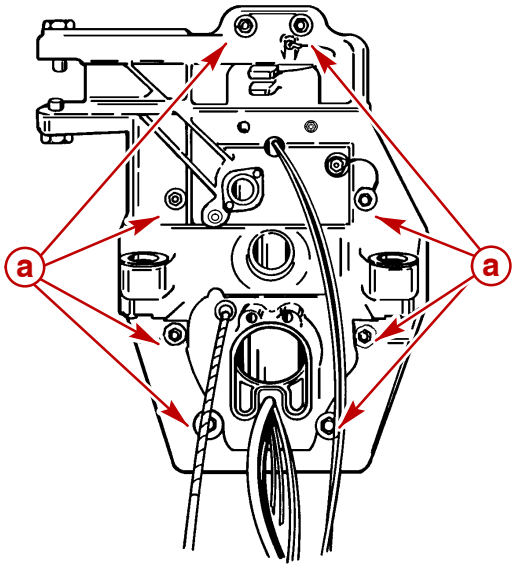
a - Gear lube monitor hose
b - Quick release 90 degree fitting
c - Gimbal housing fitting
d - Quick release button

11. On diesel models with water bypass fitting, remove the fitting.



a - Water bypass fitting

12. Remove transom locknuts and washers.



73902

a - Locknuts and washers (8)

13. Separate the inner transom plate from the gimbal housing assembly.

Transom Assembly Installation

1. Insert wires, hoses, and shift cable through appropriate openings in inner transom plate.
2. Position gimbal housing on transom and hold in place.

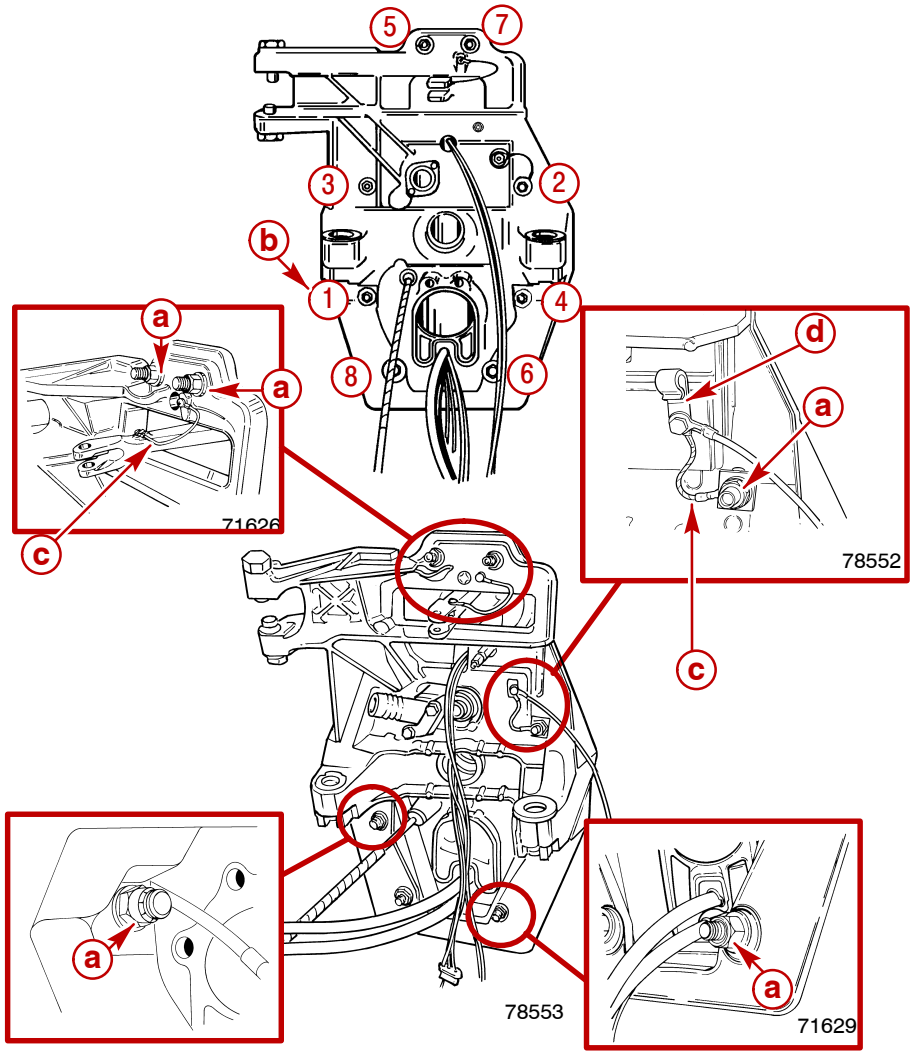
IMPORTANT: Tighten the transom assembly fasteners using an X-pattern torque sequence, starting from the middle fasteners. Tighten in small increments and go around the pattern several times until the proper torque is achieved.

3. Secure transom assembly with hardware as shown. Torque the hardware.

Description	Nm	lb-in.	lb-ft
Transom assembly hardware	34		25

4. Attach continuity wires.

IMPORTANT: Steering lever continuity circuit wire must be positioned as shown to avoid stressing wire when steering lever moves.



a - Locknuts and flat washers (8)
b - Torque sequence
c - Continuity wires (2)
d - J-clip

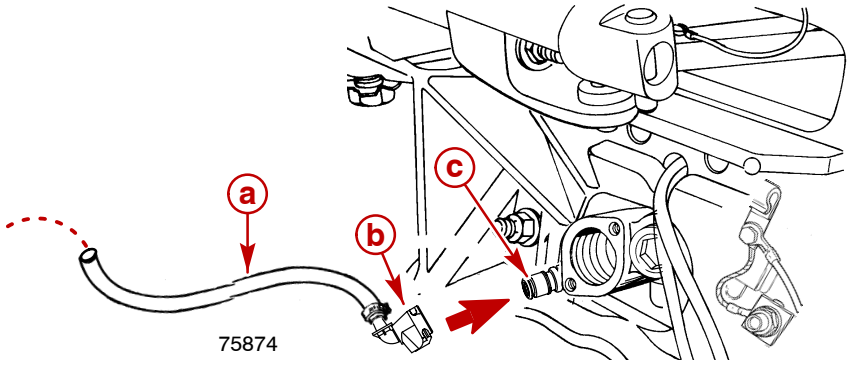
5. Connect gear lube monitor hose.

⚠ CAUTION

Avoid sterndrive unit damage. Quick release button on gear lube monitor 90 degree hose fitting may not lock on gimbal housing if touching or depressed by water inlet fitting or block-off plate, if equipped. Failure to do so could result in a loose 90 degree fitting causing a loss of gear lube and damage to sterndrive unit.

NOTE: *Models not equipped with the quick release fitting use a gear lube monitor hose with a brass thread on the fitting to the gimbal housing.*

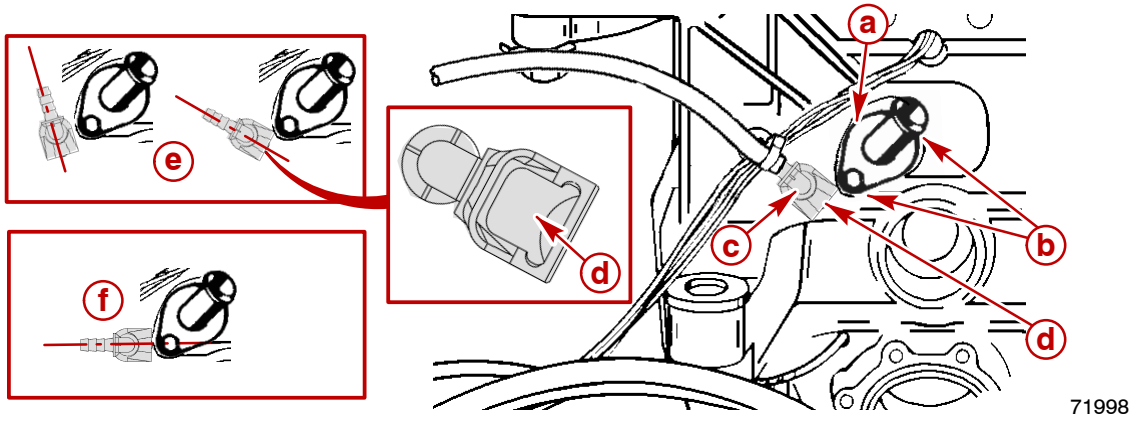
a. Connect the quick release 90 degree fitting of the gear lube monitor hose to the gimbal housing.



a - Hose
b - Quick release 90 degree fitting
c - Gimbal housing fitting

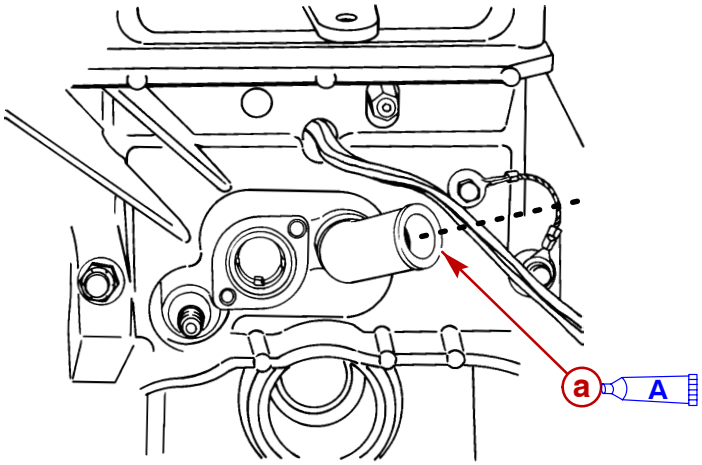
NOTE: *The quick release button on hose fitting must be positioned away from water inlet fitting, or block-off plate if equipped. Release button must not contact water fitting or block-off plate, if equipped.*

b. Position quick release button on hose fitting away from water inlet fitting. Release button must not contact water inlet fitting.



a - Water inlet fitting
b - Star washer and screw
c - 90 degree hose fitting
d - Quick release button
e - ACCEPTABLE positions
f - NOT ACCEPTABLE position

6. **Models with Water Bypass Fitting:** Apply sealant to threads and install fitting. Tighten securely and position as shown.

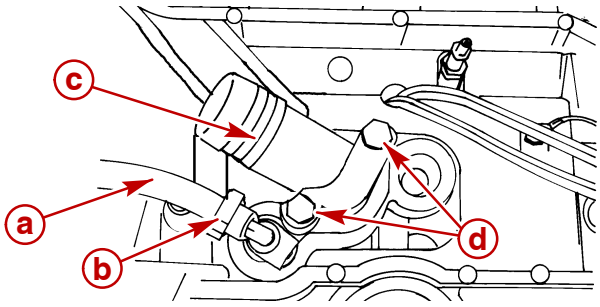


76656

a - Water bypass fitting

Description		Where Used	Part Number
A	Perfect Seal	Water bypass fitting	92-34227-1

7. Install water inlet fitting with gasket.

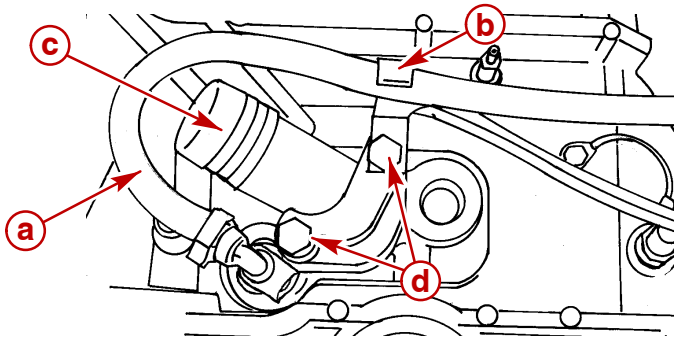


76640

a - Gear lube monitor hose
b - Hose clamp
c - Water inlet fitting
d - Bolts and star washers

Description	Nm	lb-in.	lb-ft
Water inlet fitting bolts	5	45	

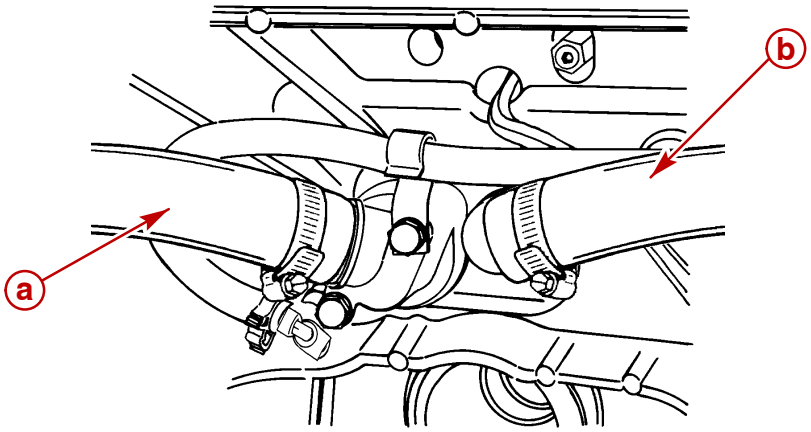
8. **On Some Models:** The gear lube monitor hose may be routed toward the port side of the engine. Secure the hose at the top side of the water inlet fitting using the hose clip as shown.



76635

a - Gear lube monitor hose
b - Hose clip
c - Water inlet fitting
d - Bolts and star washers

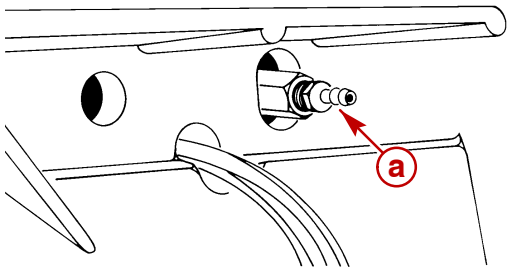
9. Connect water hoses to appropriate fittings. Tighten hose clamps securely.



76641

a - Seawater hose to engine seawater pump
b - Seawater pickup hose

10. Connect the speedometer hose to the speedometer fitting.

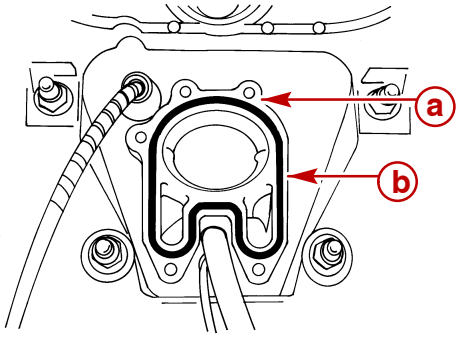


70015

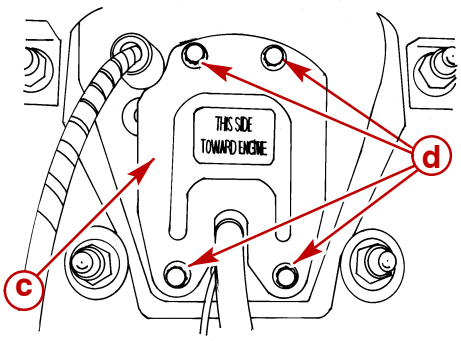
a - Speedometer fitting

IMPORTANT: Exhaust pipe or block-off plate and gimbal housing mating surface must be clean and free of nicks and scratches and O-ring must be properly seated in groove or water may leak into boat.

11. **Through the transom exhaust models:** Install block-off plate as shown, using 4 bolts and lockwashers. Torque bolts.



76639

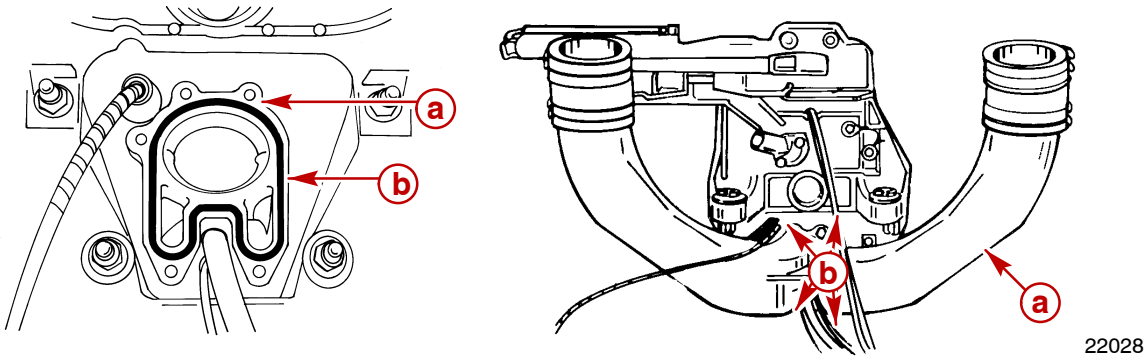


76638

a - Mating surface
b - O-ring
c - Bolts and lockwashers (4)
d - Block-off plate

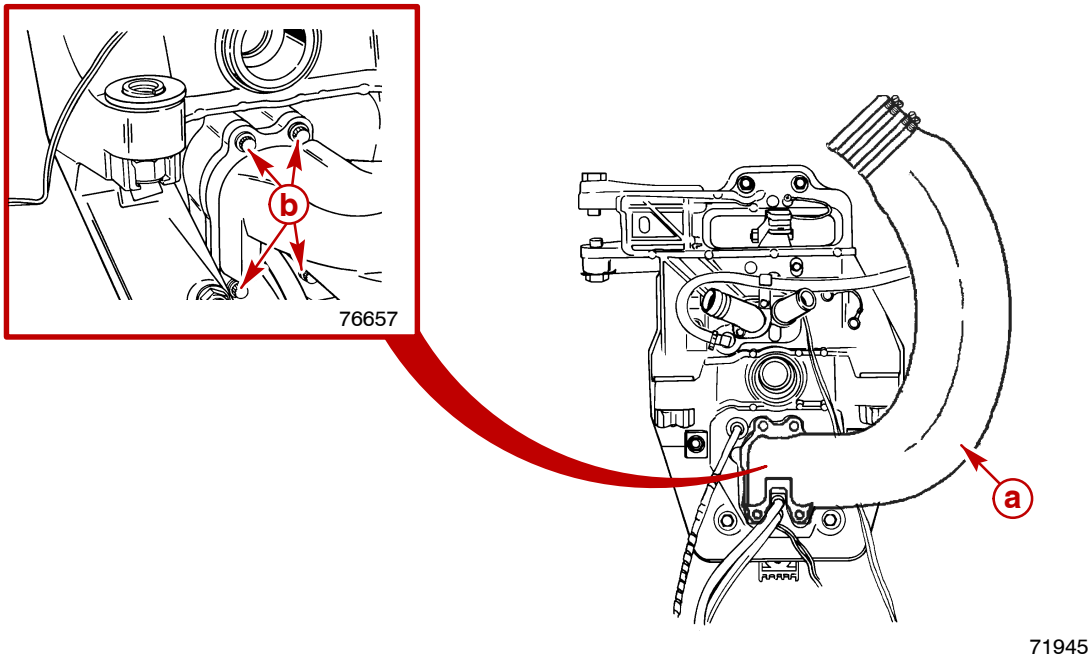
Description	Nm	lb-in.	lb-ft
Exhaust block-off plate bolts	34		25

12. **Through the prop exhaust models:** Install exhaust pipe. Torque bolts.



Typical V6 and V8 gasoline engines

a - Mating surface
b - O-ring
c - Exhaust pipe
d - Bolts (4)



Typical diesel engine

a - Exhaust pipe
b - Bolts (4)

Description	Nm	lb-in.	lb-ft
Exhaust pipe to gimbal housing bolts	34		25

IMPORTANT: Make hydraulic hose connections as quickly as possible to prevent oil from leaking out of the system.

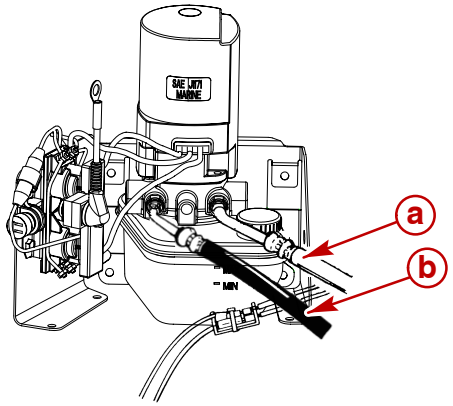
⚠ WARNING

Avoid serious bodily injury or death due to loss of steering control. Extreme heat will lower burst pressure or melt steering system hydraulic hoses. Stress on hose fittings or kinks in the hose may cause hose failure. In any case, instant loss of steering may occur. Route the hydraulic hoses to avoid extreme heat, stress on hose fittings and hose kinks.

⚠ CAUTION

Installing trim pump hoses improperly can damage the hose fittings and cause leaks or loose lines. Do not cross thread or overtighten the hose fittings.

13. Connect the power trim pump hydraulic hoses. Torque both hose fittings.



76631

a - DOWN pressure hydraulic line (GRY)
b - UP pressure hydraulic line (BLK)

Description	Nm	lb-in.	lb-ft
Power trim hydraulic hose fittings	9	80	

Installing Steering System

HYDRAULIC (HELM) STEERING

If your power package is equipped with Compact Hydraulic Steering, refer to the *Compact Hydraulic Steering Installation Instructions*. Complete the installation of the hydraulic steering system before proceeding to Transom Preparation.

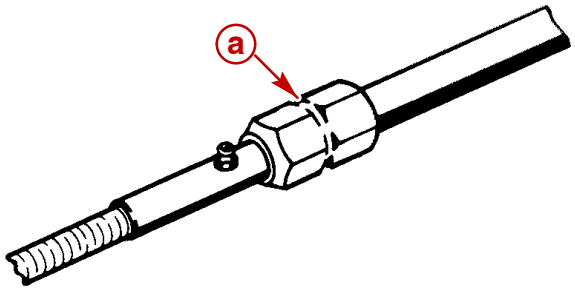
STEERING HELM AND CABLE

Transom assembly is shipped with the steering cable guide tube preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

WARNING

Failure to use a steering cable locking device could cause loss of steering, which could cause damage to the boat and/or injury.

NOTE: *All current production Quicksilver RideGuide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)*



22060

a - Quicksilver RideGuide steering cable self-locking coupler nut (identified by groove)

IMPORTANT: If using a steering cable that does not have a self-locking coupler nut, an external locking device such as a locking sleeve must be used.

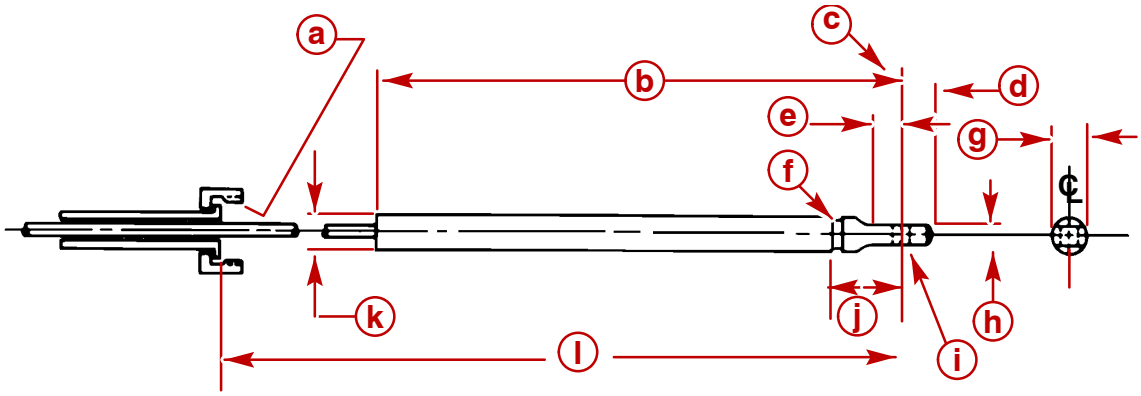
⚠ CAUTION

If steering cable with improper dimensions is installed, severe damage to transom assembly and/or steering system may result.

1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks, or loops in cable.
3. Fully extended steering cable end dimension must be as shown.

STEERING CABLE SPECIFICATIONS

IMPORTANT: Power steering pump lugging (squealing) in a hard right turn (against lock) may mean a steering cable has been installed that does not have the correct dimensions.



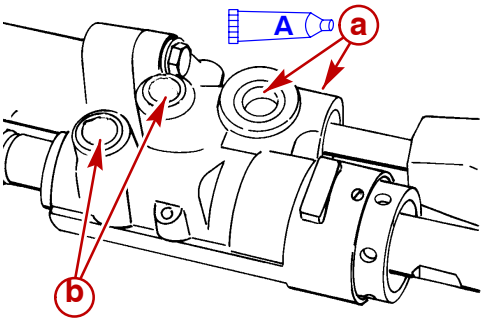
21435

a - Coupler nut - 7/8 - 14 UNF - 28 thread
b - 298 mm (11-3/4 in.) minimum
c - Interface point
d - 12.7 mm (1/2 in.) maximum
e - 10.7 mm (27/64 in.) minimum flat
f - 3.1 mm (7/64 in.) minimum radius
g - 15.9 mm (5/8 in.) maximum diameter end fitting
h - 9.5 mm (3/8 in.)
i - 9.8 mm (3/8 in.) diameter through hole (chamfered each side)
j - 34.9 mm (1-3/8 in.) maximum
k - 15.9 mm (5/8 in.) diameter tube
l - Cable travel: mid-travel position - 429 mm (16-7/8 in.)
total travel to be 203 mm (8 in.) minimum to 228 mm (9 in.) maximum
travel each side of mid-travel position - 102 mm (4 in.) minimum to 114 mm (4-1/2 in.) maximum

POWER STEERING

NOTE: For dual installations, *power steering unit can be mounted on port or starboard transom assembly. Measure exact distance between power package centerlines. Select a tie bar from Mercury Precision Parts / Quicksilver Accessory Guide. Refer to tie bar installation instructions before proceeding.*

1. Inspect the upper and lower bushings for debris. Lubricate the upper and lower bushings.

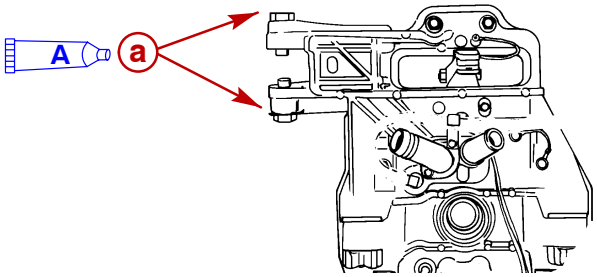


73898

a - Upper and lower bushings (lower bushing not shown)
b - Control valve ports

Description		Where Used	Part Number
A	Special Lubricant 101	Steering system bushings	92-802865A1

2. Loosen the upper and lower pivot bolts and ensure that the threads are well lubricated. Add lubricant as necessary.



71945

a - Upper and lower pivot bolts

Description		Where Used	Part Number
A	Special Lubricant 101	Steering system pivot bolts	92-802865A1

3. Install steering assembly as follows:
   a. Position steering assembly so that pivot bolts will enter bushings in pivot block or power steering control valve.
   b. Install upper and lower pivot bolts along with tab washers. Ensure that tab washer tangs straddle the ridge on inner transom plate.
   c. Turn pivot bolts all the way in by hand to ensure proper alignment.
   d. Ensure that steering assembly pivots freely.

4. Torque pivot bolts.

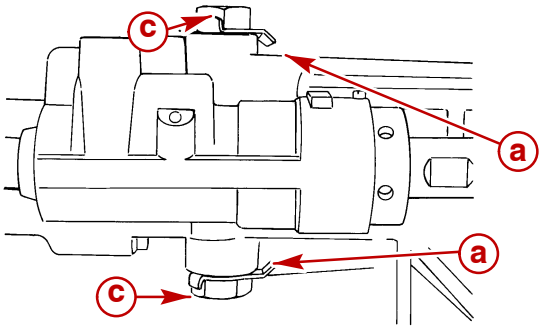
Description	Nm	lb-in.	lb-ft
Steering system pivot bolts	34		25

NOTE: *It may be necessary to tighten further to align flats on pivot bolt with tangs on tab washer.*

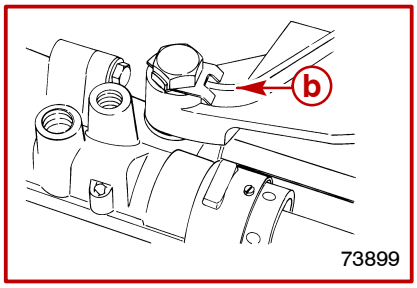
5. Bend tab washer tangs against corresponding flats on bolt heads.

⚠ CAUTION

Avoid injury or property damage due to loss of steering control. Always bend tab washer tangs against the corresponding flats of the steering pivot bolts.



73900



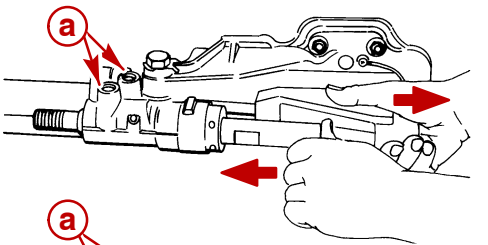
73899

a - Tab washers
b - Ridge
c - Pivot bolts

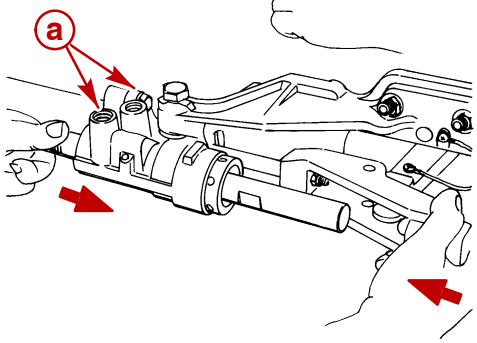
⚠ CAUTION

MOVING THE CONTROL VALVE RAM with the hoses disconnected will expel fluid from the control valve ports. Wear eye protection.

6. The control valve ram may be stiff and difficult to move when you attempt to pull it out or push it in for installation. Move the assembly in the directions shown below.



74145



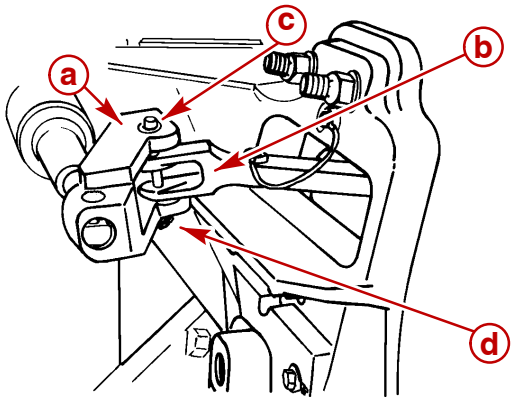
74144

a - Control valve ports

7. Connect clevis to steering lever.
8. Lubricate clevis pin and insert clevis from top to connect the steering lever to the clevis.
9. Insert cotter pin through rear clevis pin and spread both ends of cotter pin.

⚠ CAUTION

Avoid injury or property damage due to loss of steering control. Always install the clevis pin through the top of the clevis and steering lever.



71904

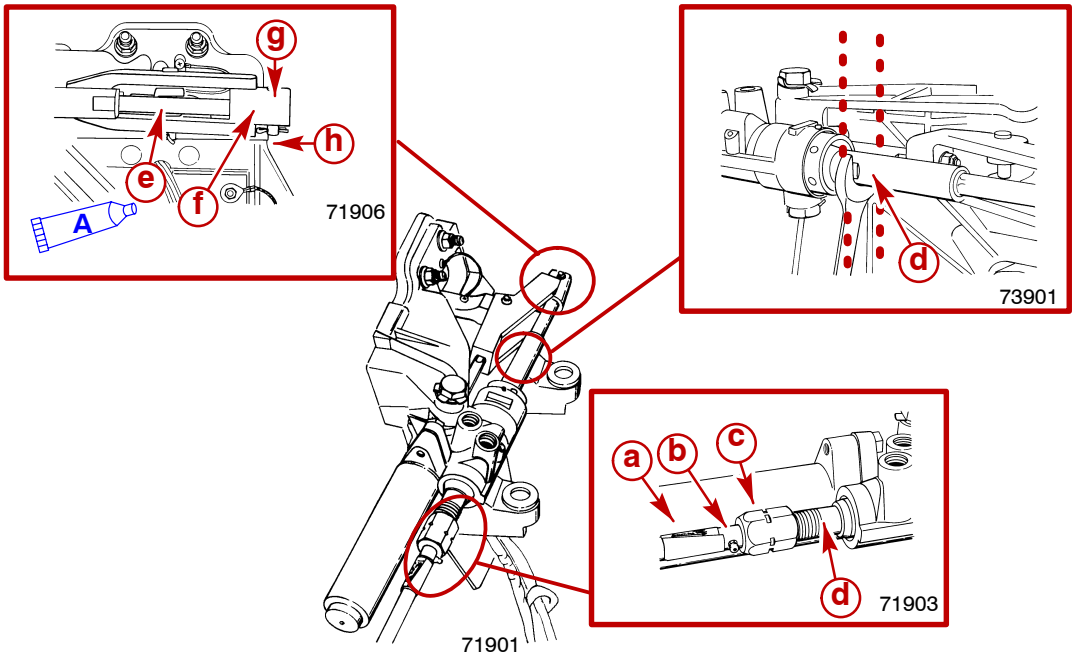
a - Clevis
b - Steering lever
c - Rear clevis pin
d - Cotter pin

Description	Where Used	Part Number
Special Lubricant 101	Clevis pin	92-802865A1

⚠ CAUTION

Steering cable outer casing must be free to move back and forth for steering system to function properly. Do not fasten any items to steering cable.

10. Coat steering cable end with a liberal amount of lubricant.
11. Install steering cable and secure with hardware.



a - Steering cable
b - Grease fitting
c - Cable coupler nut
d - Cable guide tube
e - Steering cable end
f - Clevis
g - Rear clevis pin
h - Cotter pin

Description		Where Used	Part Number
A	Special Lubricant 101	Steering cable end	92-802865A1

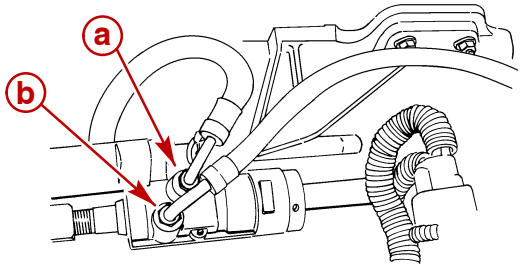
IMPORTANT: Slight feedback in the steering system could be encountered if the cable guide tube flat surfaces are not positioned vertically.

12. Using a suitable wrench hold the flat surfaces on the cable guide tube in the vertical position. Torque coupler nut.

Description	Nm	lb-in.	lb-ft
Steering cable coupler nut	47		35

NOTE: *It may be necessary to tighten further to vertically align flat surfaces after torquing.*

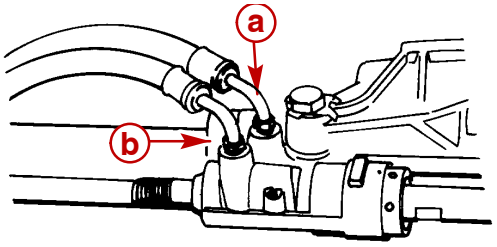
13. Install the engine. Refer to the appropriate Mercury MerCruiser Engine Service Manual.
14. Attach both hydraulic hose fittings. Route hoses as appropriate to avoid contact with the steering system components.



73860

Models with one hose routed behind power steering control valve

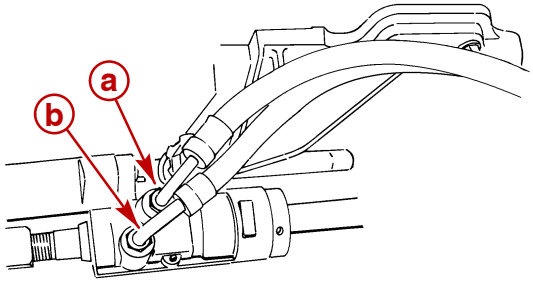
a - Rear pressure hose
b - Front return hose



74248

Models with both hoses routed behind power steering control valve toward starboard side

a - Rear pressure hose
b - Front return hose



73786

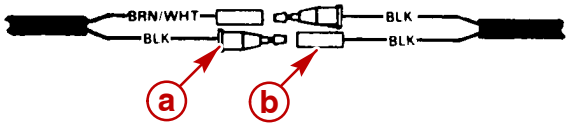
Models with both hoses routed over transom plate

a - Rear pressure hose
b - Front return hose

15. Torque both fittings.

Description	Nm	lb-in.	lb-ft
Power steering hydraulic hose fittings	34		25

16. Connect the trim sender leads from the gimbal housing to leads from the engine harness.

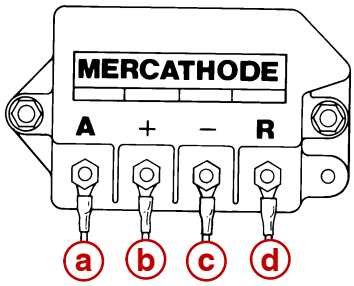


24841

a - Bullet connectors - from engine harness
b - Bullet connectors - from transom assembly

Description	Where Used	Part Number
Liquid Neoprene	All electrical connections	92-25711-3

17. Connect the MerCathode wires at the blue MerCathode controller or connect the male and female connectors of the quick connect.



22232

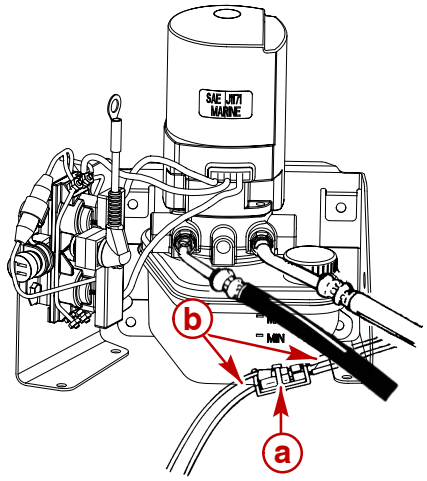
Standard MerCathode connections shown

a - ORN Lead - from anode on transom assembly
b - RED/PUR Lead - connect (other end) to positive (+) battery terminal
c - BLK Lead - from engine harness
d - BRN Lead - from electrode on transom assembly

18. Apply a thin coat of lubricant to all electrical connections.

Description	Where Used	Part Number
Liquid Neoprene	All electrical connections	92-25711-3

19. Connect the trim limit switch wires.



76631

a - Tie strap
b - Trim limit switch wires

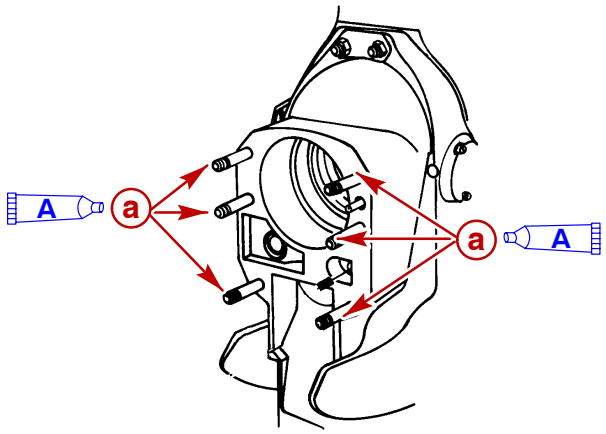
Description	Where Used	Part Number
Liquid Neoprene	All electrical connections	92-25711-3

Sterndrive Unit Installation

1. Install and align the engine. Refer to the appropriate engine service manual.

NOTE: *If the engine was removed and the shift cable was disconnected, reinstall and adjust the shift cable before proceeding.*

2. Place the remote control shift lever in the NEUTRAL position.
3. Lubricate the bell housing studs.

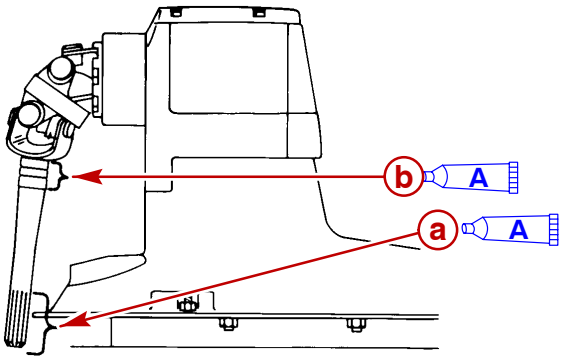


76674

a - Bell housing studs

Description		Where Used	Part Number
A	2-4-C with Teflon	Bell housing studs	92-802859A1

4. Lubricate the U-joint shaft splines and the O-rings.

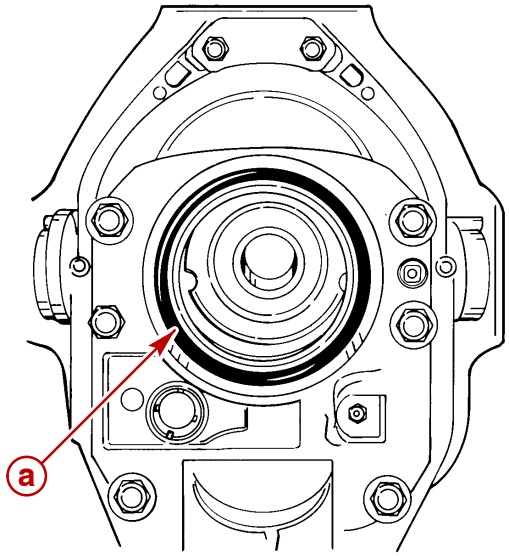


22026

a - U-joint shaft splines
b - U-joint shaft O-rings

Description		Where Used	Part Number
A	Engine Coupler Spline Grease	U-joint shaft splines and O-rings	92-802869A1

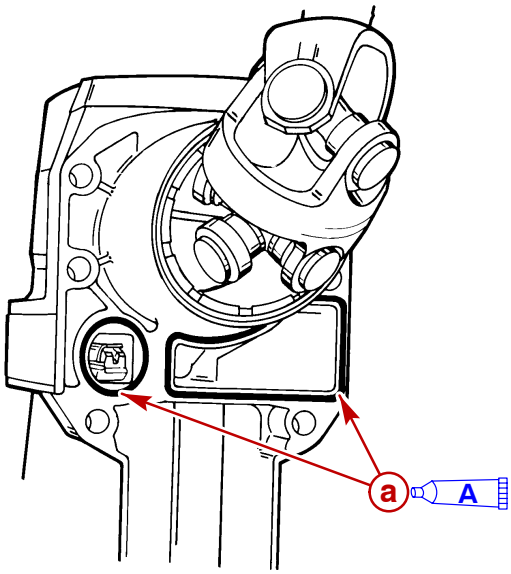
IMPORTANT: The edge of the U-joint bellows acts as a seal between the bell housing and the sterndrive shaft housing. Ensure that the surface is not damaged.



24725

a - Sterndrive shaft bellows edge

5. Inspect the U-joint bellows for cracks, nicks, and cleanliness. Replace or clean the bellows as necessary.
6. Lubricate the O-ring seals on the face of the sterndrive shaft housing.

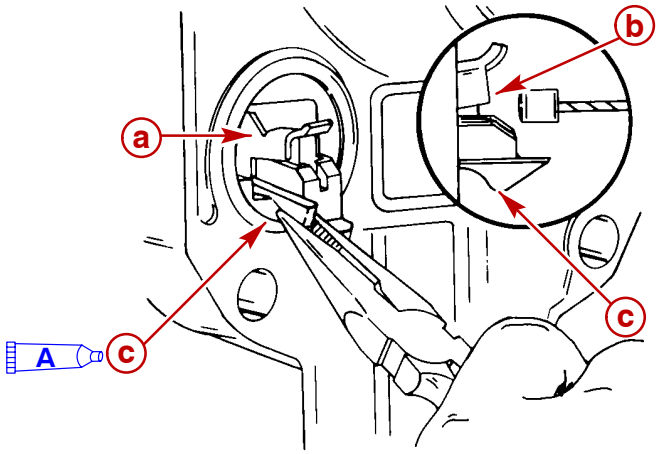


22031

a - O-ring seals

Description		Where Used	Part Number
A	U-joint and Gimbal Bearing Grease	O-ring seals	92-802870A1

7. Pull out the shift linkage as far as possible. The jaws will open. Lubricate the underside of the lower lip of the shift linkage assembly.



22025

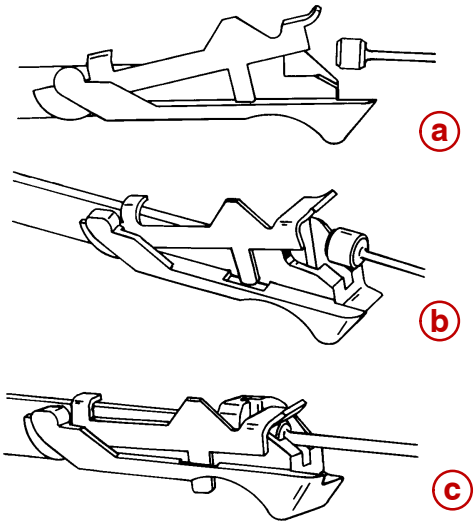
a - Shift linkage assembly
b - Jaws open
c - Underside of lower lip

Description		Where Used	Part Number
A	Special Lubricant 101	Sterndrive shift linkage assembly	92-802865A1

8. Ensure that shift lever is in the NEUTRAL position.

IMPORTANT: As you are inserting the sterndrive unit into the bell housing, the entrance of the bell housing shift cable must be closely checked to ensure that the cable enters the jaws of the shift linkage assembly in the sterndrive unit.

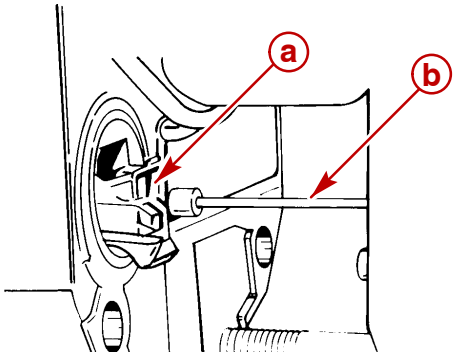
NOTE: *As the shift cable enters the shift linkage assembly, it pushes the assembly back into the sterndrive shaft housing and the jaw closes securing the cable as shown in "**a**", "**b**", and "**c**."*



22025

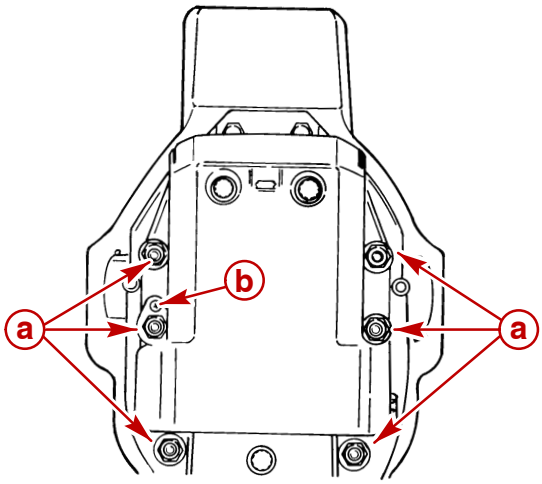
Shift linkage assembly and shift cable

NOTE: *If the shift cable does not line up to properly enter the shift linkage jaws, use your hand to guide the cable into place while installing the sterndrive unit.*



a - Shift linkage jaws
b - Shift cable

9. Install the sterndrive unit.
   a. Position the trim cylinders so that they point straight backwards (aft).
   b. Align the U-joint shaft with the bell housing bore. Ensure the studs on the bell housing align with the appropriate holes on the sterndrive unit.
   c. Guide the U-joint shaft through the gimbal bearing and into the engine coupler. Ensure that the shift linkage jaws engage with the shift cable.
   d. If necessary, rotate the propeller shaft slightly to align the U-joint shaft splines with the engine coupler splines, then slide the sterndrive unit completely into the bell housing.
   e. Rotate the propeller shaft slightly to ensure that the sterndrive unit is still in NEUTRAL once installed.
10. Fasten the sterndrive unit to the bell housing. Start from the center and torque the nuts.



22031

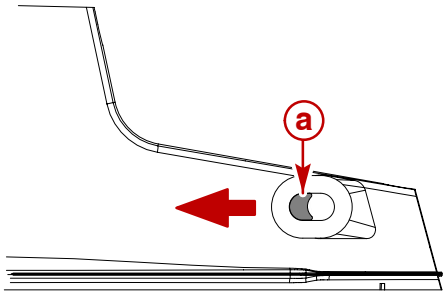
a - Locknuts (6) and flat washers (5)
b - Ground plate (flat washer not used here)

Description	Nm	lb-in.	lb-ft
Sterndrive unit to bell housing attaching nuts	68		50

IMPORTANT: On Bravo One, Two and Three Models, the trim-in limit insert must be properly positioned before installing the trim cylinder anchor pin in the following steps.

NOTE: *Ensure that the trim-in limit insert is reinstalled in the same position that it was in prior to removal of the sterndrive unit. If you are not sure of it's original position, contact the boat manufacturer for their recommendation. Refer to Special Information at the front of this section before installing the trim-in limit insert.*

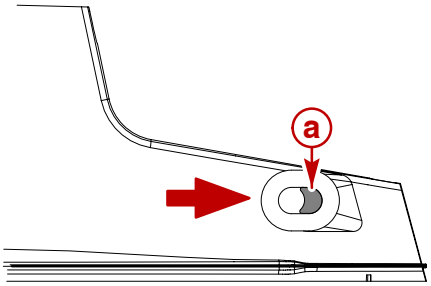
11. Ensure that the trim-in limit insert is positioned as shown for the appropriate Bravo model.



75157

Bravo One and Two (positioned forward)

a - Trim-in limit insert



75158

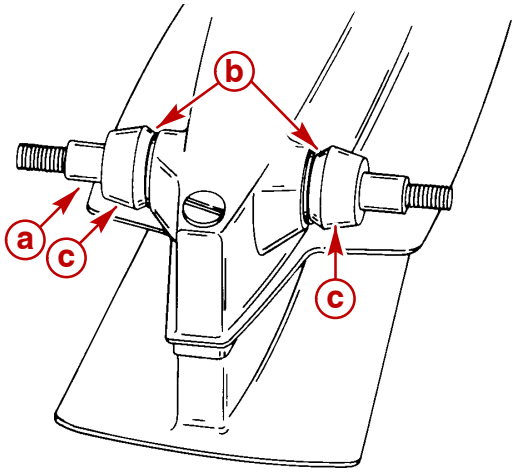
Bravo Three (positioned aft)

a - Trim-in limit insert

IMPORTANT: The position of the trim-in limit insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

12. Insert the aft anchor pin through the hole in the sterndrive shaft housing.

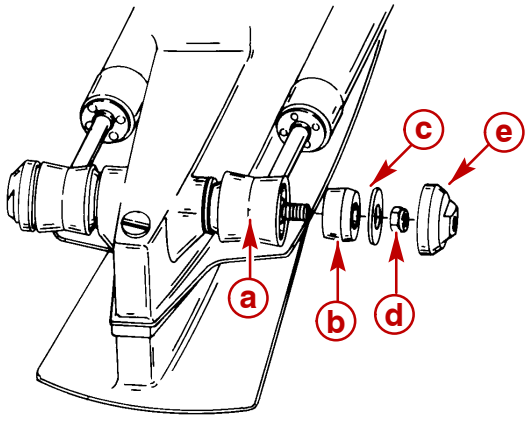
13. Place a large ID flat washer and bushing on each end of the anchor pin. Install the bushings with the small diameter end facing outward.



22029

a - Anchor pin
b - Large ID washers
c - Bushings

14. Loosen the nuts that secure the trim cylinders to the forward anchor pins. Move the cylinder pivot ends outward and place them over the aft anchor pin.
15. Place the bushings (with the smaller diameter end facing inward) and the small ID flat washers onto each end of the anchor pin. Install locknuts.
16. Tighten the forward and aft anchor pin locknuts until the locknuts and washers contact against anchor pin shoulder.
17. Attach the trim cylinder caps hand-tight. If the caps will not catch the threads, check the tightness of the anchor pin nuts.



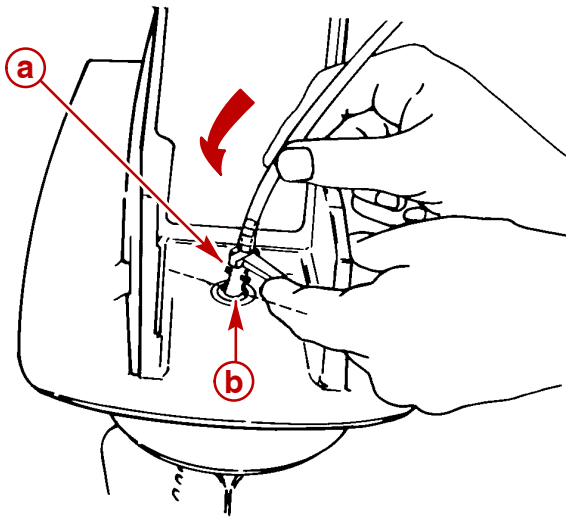
22029

a - Trim cylinder pivot ends
b - Bushing
c - Small ID flat washer
d - Locknut
e - Trim cylinder cap

18. Attach the speedometer hose fitting to the sterndrive unit.

a. Raise the sterndrive unit to gain access to the area between the gimbal housing and the sterndrive unit. Locate the opening in the forward end of the anti-ventilation plate.

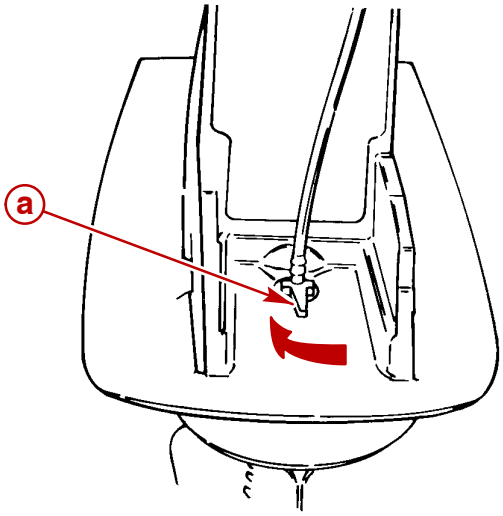
b. Insert the speedometer hose fitting into the opening.



22025

a - Speedometer hose fitting
b - Opening

c. With the fitting fully seated, turn the handle clockwise to a tightly seated position.



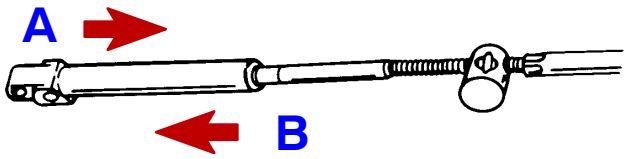
22025

a - Speedometer hose fitting installed (handle pointing forward)

Shift Cable Installation

IMPORTANT: Sterndrive unit propeller rotation is determined by the shift cable installation in the remote control.

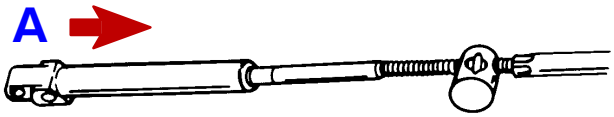
- **Bravo One/Two - If shift cable end guide moves in direction "A" when control lever is placed in FORWARD, remote control is set up for RIGHT-HAND (RH) propeller rotation.**
- **Bravo One/Two- If shift cable end guide moves in direction "B" when control lever is placed in FORWARD, remote control is set up for LEFT-HAND (LH) propeller rotation.**



71656

Control box shift cable. Arrow indicates direction of motion

- **Bravo Three - Front propeller on sterndrive unit is always LH Rotation and rear propeller is always RH Rotation. Shift cable end guide must move in direction "A" when control lever is placed in FORWARD gear position.**



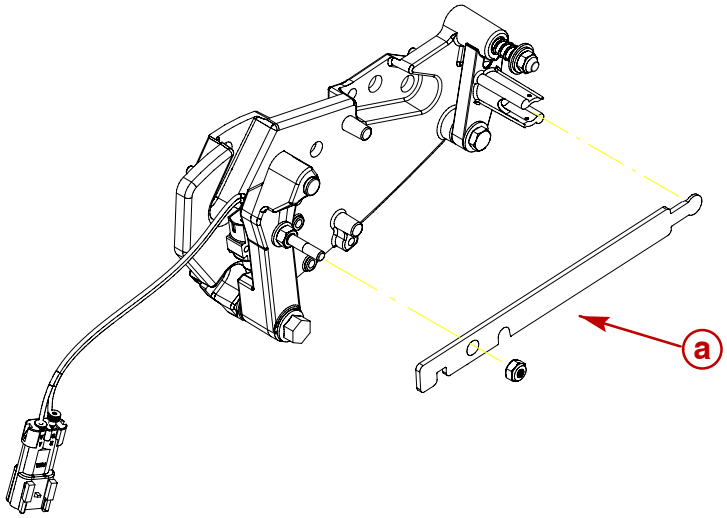
71656

Control box shift cable. Arrow indicates direction of motion

IMPORTANT: When installing shift cables, ensure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. Do not fasten any items to shift cables.

NOTE: *Bravo Models Only: Using Adjustment Tool (91-12427), shift cables can be adjusted without or with the sterndrive installed.*

1. Remove the adjustment tool.



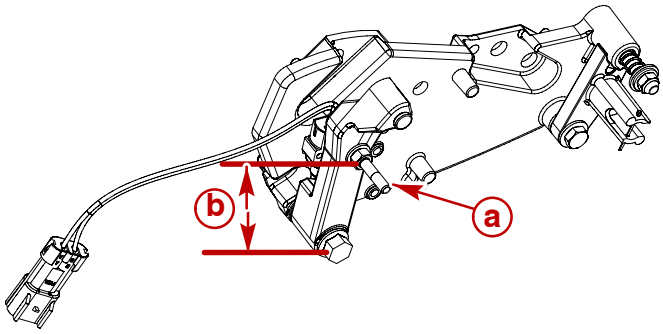
78544

Typical shift plate

a - Shift cable adjustment tool

Shift Cable Adjustment Tool		
73479	Attaches over the shift cable. Use for proper Bravo sterndrive unit shift cable adjustment at the shift plate.	91-12427

2. Loosen the adjustable stud and move it to dimension shown. Retighten stud.

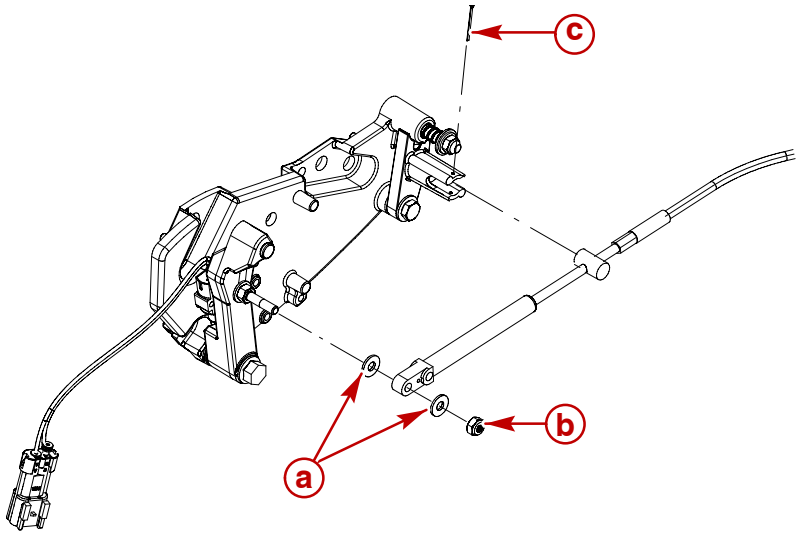


78496

Typical shift plate

a - Adjustable stud
b - 76 mm (3 in.) (Center of pivot bolt to center of stud)

3. Install sterndrive unit shift cable.
4. Tighten locknut until it contacts and then loosen 1/2 turn.
5. Insert cotter pin from top and spread ends.

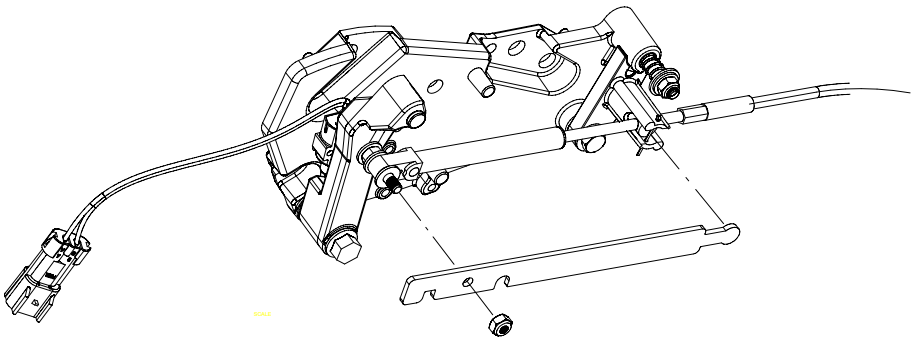


78609

Typical shift plate

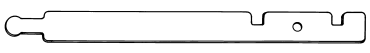
a - Washers (2)
b - Locknut
c - Cotter pin

6. Place adjustment tool over sterndrive unit shift cable. Hold tool in place, using a piece of tape over the barrel retainer.



78498

Typical shift plate

Shift Cable Adjustment Tool		
 73479	Attaches over the shift cable. Use for proper Bravo sterndrive unit shift cable adjustment at the shift plate.	91-12427

7. Locate center of remote control and control cable play (backlash).

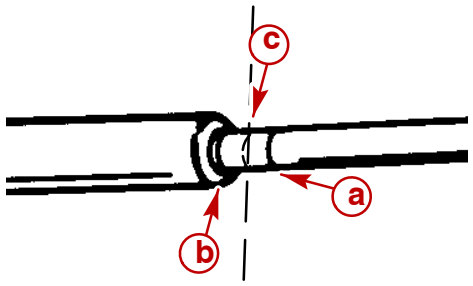
IMPORTANT: Ensure center mark "c" is aligned with control cable end guide edge when making the following adjustment.

a. Shift remote control to NEUTRAL.

b. Push in on control cable end with enough pressure to remove play and mark position "a" on tube.

c. Pull out on control cable end with enough pressure to remove play and mark position "b" on tube.

d. Measure distance between marks "a" and "b" and mark position "c" half-way between marks "a" and "b."



71656

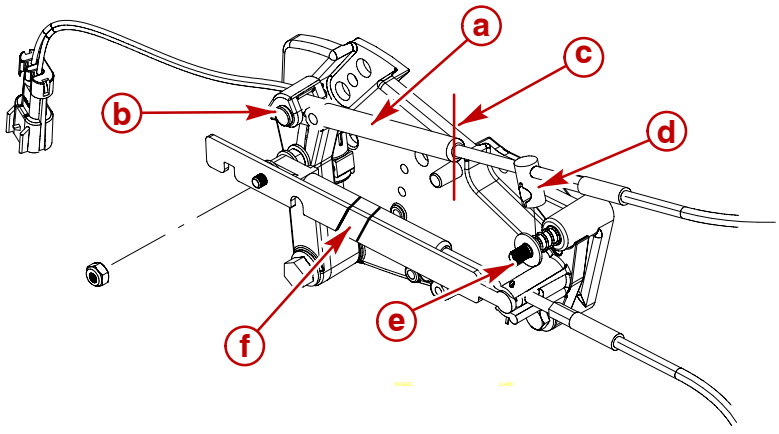
8. Temporarily install control cable end guide into shift lever and insert anchor pin.

9. Adjust control cable barrel so that hole in barrel centers with vertical centerline of stud. Ensure that backlash center mark is aligned with edge of control cable end guide.

⚠ CAUTION

Do not attempt to install or remove control cable barrel from stud without first removing end guide anchor pin from shift lever and removing cable. Attempting to bend control cable to install or remove barrel will place undue stress on cable end guide and shift lever and damage to both could occur.

10. Remove control cable end guide from shift lever by removing clevis pin.

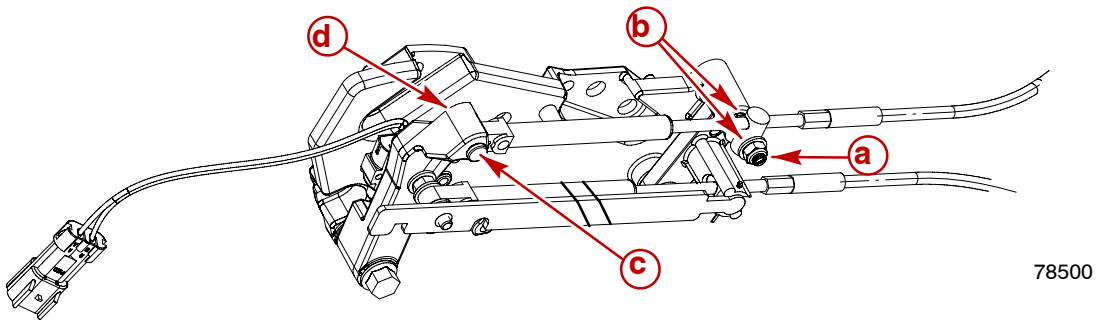


78499

Typical shift plate

a - Control cable end guide
b - Clevis pin
c - Backlash center
d - Control cable barrel
e - Stud
f - Tape

11. Install the control cable.
12. Install the washer and locknut.
13. Tighten the locknut until it contacts and then loosen 1/2 turn.
14. Install the clevis pin.
15. Install the cotter pin into the clevis pin from the top and spread the ends.

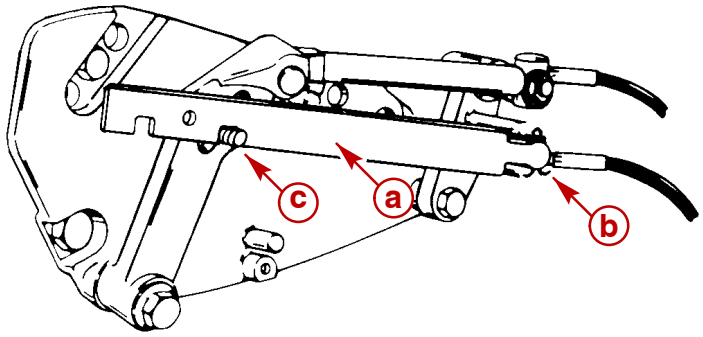


Typical shift plate

- **a -** Locknut
- **b -** Washers - both sides of barrel
- **c -** Clevis pin
- **d -** Cotter pin (not shown)

16. Remove the adjustment tool.
17. Shift remote control lever into FORWARD position. Place end of adjustment tool in barrel retainer. If slot does not fit over stud, loosen shift lever stud and slide stud up or down until slot in tool fits over stud. When adjustment is correct, retighten stud.
18. Lift the adjustment tool so that the slot is above the stud.

19. Shift the remote control into REVERSE and repeat the adjustment process.

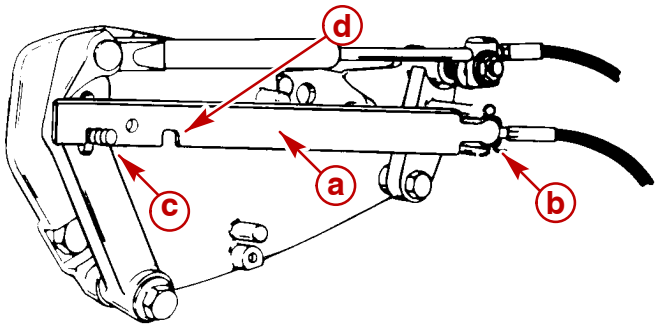


71662

Typical shift plate

RH Rotation Bravo One, Two and Three Forward

LH Rotation Bravo One and Two Reverse



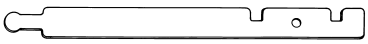
71663

Typical shift plate

RH rotation Bravo One, Two and Three reverse

LH rotation Bravo One and Two forward

a - Adjustment tool
b - Barrel retainer
c - Shift lever stud
d - Shift lever adjustment slot

Shift Cable Adjustment Tool		
 73479	Attaches over the shift cable. Use for proper Bravo sterndrive unit shift cable adjustment at the shift plate.	91-12427

20. Remove adjustment tool.

21. Lubricate shift cable pivot points.

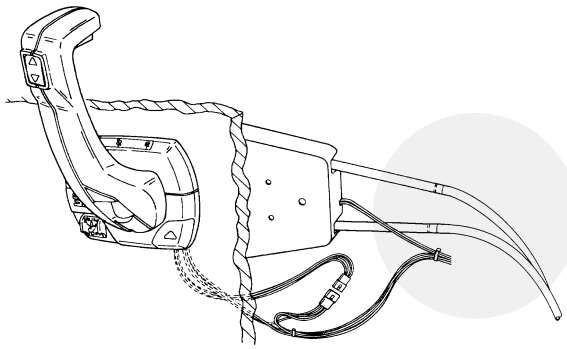
Description	Where Used	Part Number
SAE 30W Engine Oil	Shift cable pivot points	Obtain locally

Troubleshooting Shift Problems

NOTE: *The following information is provided to assist an installer in troubleshooting if hard shifting or chucking/racheting is encountered when shifting into FORWARD gear.*

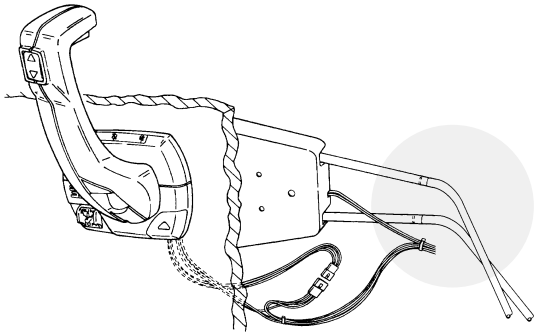
1. When installing the control box in the side panel of the boat, ensure that the cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back toward any fiberglass structure, the cables will be interfered with; this will cause very hard shifting.

NOTE: *The control box housing can be rotated in 30 degree increments to improve cable routing.*



74688

Proper cable bend

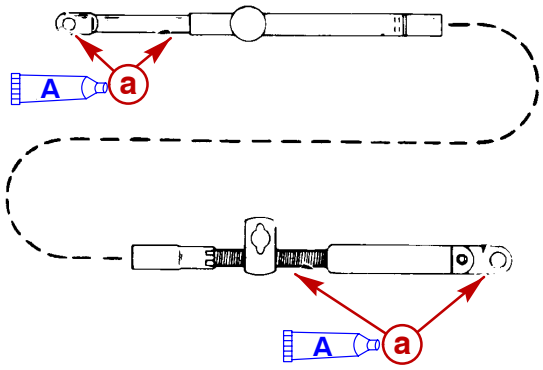


74689

Improper cable bend

2. Ensure that when the shift cable from the control box is led through the side gunnel of the hull, it does not have any extremely sharp bends in it as this will cause stiff shifting.

3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and grease it with lubricant. Move it back and forth to allow even distribution of the grease.



22005

a - Shift cable end

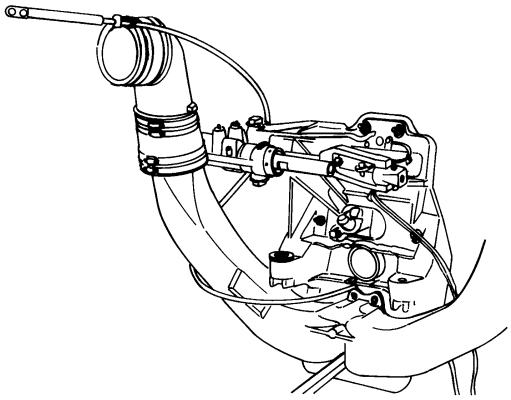
Description		Where Used	Part Number
A	2-4-C with Teflon	Shift cable end	92-802859A1

4. Do not strap or clamp the control cables to any other cables or rigid structure within 9.14 m (3 ft) of the control box.
5. Ensure that the cable is not permanently kinked.
6. Ensure that there is proper clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either FORWARD or REVERSE.
7. Ensure that the engine was not set down on the intermediate shift cable during installation, as this will crush the inner cable tubing and cause improper and / or stiff shifting.
8. Do not fasten the shift cable with straps or clamps to any other cable within 1.5 m (5 ft) of the shift plate.
9. Do not fasten the shift cable to the transom with any type of plastic clips or fasteners within 1.5 m (5 ft) of the shift plate.
10. Do not overtighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.
11. Lubricate attaching points with engine oil.

Description	Where Used	Part Number
SAE 30W Engine Oil	Shift cable pivot points	Obtain locally

12. Check the intermediate shift cable routing from the transom assembly to the shift plate as follows:
    a. The cable should come through the transom, above the exhaust pipe and make a turn toward the starboard side of the boat between the exhaust pipe and the engine flywheel housing.
    b. The cable should then be routed under the starboard rear engine mount and turn toward the transom.
    c. The cable should then go up behind the power steering valve and loop over to the shift plate on the engine, where it is connected to the anchor points on the shift plate.

Following this routing will prevent the engine coupler from damaging the cable.



74901

NOTE: *A final check of the adjustments should be made with the boat in the water and engine running. If this cannot be done or is not done at your manufacturing facility, arrangement should be made with the dealer to do this as part of the predelivery inspection.*

STERNDRIVE UNIT

Section 3A - Drive Shaft Housing

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3 A

Identification

U-joint and Pinion Gear

The following Bravo sterndrive units are equipped with Permalube non-regreasable U-joints.	
Dual Water Pickup 1.5:1	0M160890 - Current
Dual Water Pickup 1.36:1	0M130898 - Current
Dual Water Pickup 1.50:1	0M161523 - Current
Dual Water Pickup 1.65:1	0M168818 - Current
Bravo One 1.5:1	0M111208 - Current
Bravo Two 1.5:1	0M158602 - Current
Bravo Two 2.0:1	0M133422 - Current
Bravo Two 2.2:1	0M163866 - Current
Bravo Three 1.5:1	0M141102 - Current
Bravo Three 1.65:1	0M171803 - Current
Bravo Three 1.81:1	0M159838 - Current
Bravo Three 2.0:1	0M166042 - Current
Bravo Three 2.2:1	0M150340 - Current
Bravo Three 2.43:1	0M129436 - Current

Bravo One

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
1.65:1	C
1.50:1	F
1.36:1	H

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	rive	Driven
1.65:1	23	30
1.50:1	27	32
1.36:1	27	29

Bravo Two

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
2.20:1	C
2.00:1	F
1.81:1	H
1.65:1	T
1.50:1	F

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	29

Bravo Three

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
2.43:1	N
2.20:1	K
2.00:1	B
1.81:1	G
1.65:1	C
1.50:1	F
1.36:1	P

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
2.43:1	23	30
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	32
1.36:1	27	29

Bravo XZ

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
1.50:1	Z
1.36:1	T

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
1.50:1	27	32
1.36:1	27	29

Bravo XR

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
1.50:1	R
1.35:1	R
1.26:1	R

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
1.50:1	16	19
1.35:1	16	19
1.26:1	16	19

Diesel Bravo One X

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
1.65:1	C
1.50:1	F
1.36:1	H

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
1.65:1	23	30
1.50:1	27	32
1.36:1	27	29

Diesel Bravo Two X

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
2.20:1	C
2.00:1	F
1.81:1	H
1.65:1	T

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	29

Diesel Bravo Three X

U-JOINT IDENTIFICATION

Ratio	U-joint shaft marking
2.43:1	N
2.20:1	K
2.00:1	B
1.81:1	G
1.65:1	C
1.50:1	F
1.36:1	P

NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

Ratio	Drive	Driven
2.43:1	23	30
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	32
1.36:1	27	29

Specifications

Bearing Preloads

Description	New	Used[1]
U-joint bearings	0.7-1.0 Nm (6-10 lb-in.)	0.3-0.8 Nm (3-7 lb-in.)

[1] *Bearings are used if spun once under load.*

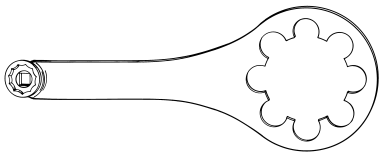
Torque Specifications

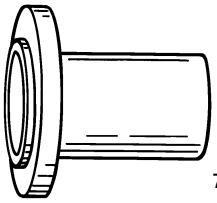
NOTE: *Securely tighten all fasteners not listed below.*

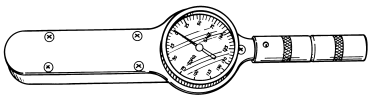
Description	Nm	lb-in.	lb-ft
Shift assembly locknuts	9	80	
Pinion gear nut	0.7-1.1	6-10	
Steel bearing adapter (Bravo X series models)	237		175
U-joint retainer nut	271		200
Shift cam cap screw	12-13	100-120	
Shift linkage cap screw	12-13	100-120	
Drive shaft housing top cover screws	27		20
Drive shaft housing rear cover screws	27		20
Anodic plate bolt	27		20
Gear housing to drive shaft housing nuts and bolts	47		35

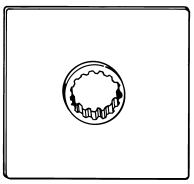
Tools

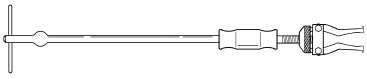
Special Tools

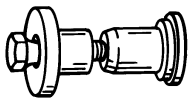
Bearing Retainer Wrench		
 73482	Installs and removes the drive shaft bearing retainer on the Blackhawk and all Mercury MerCruiser Bravo sterndrive units, excluding the Bravo X series.	91-17256

U-joint Adapter		
 74229	Supports the yoke when disassembling the U-joint on all the Mercury MerCruiser sterndrive units, excluding the Bravo X series.	91-38756

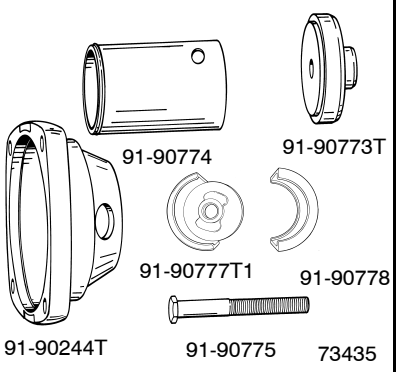
Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

Clutch Assembly Stand		
 73434	Holds the Bravo and Blackhawk clutch assemblies for servicing.	91-17301T1

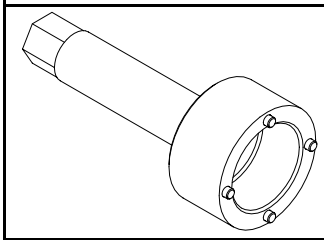
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

Bearing and Seal Installation Tool		
 73464	Installs the shifter shaft bushings on all the Bravo and Blackhawk sterndrive units.	91-17275A1

Special Tools (continued)

Puller / Driver Assembly		
	Installs and removes the drive shaft housing bearings and sleeves on all the Bravo and Blackhawk sterndrive units. Assembly includes the following and can be purchased separately: 91-90777T1 Puller Jaw 91-90778 Puller Jaw 91-90774 Puller Guide 91-90775 Puller Bolt 91-90244T Driver Guide 91-90773T Driver Head	91-90244A1

Shift Handle Tool		
	Positions and removes the shifter shaft on the Bravo One and Bravo Two sterndrive units.	91-17302

Steel Bearing Adapter Socket		
	Installs and removes the steel bearing adapter on the Bravo X Series sterndrive units and with integrated top cover units.	91-862531

Snap-On Tools

Snap-On Tools 2801 80th Street Kenosha, WI 53141 See Snap-On Catalog for phone number of distributor in your region.	
Description	**Part Number**
Snap-On-Adapter	GC-40-4
Puller Head	GC-40-A10
U-joint Press	CJ 91D

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
High Performance Gear Lube	Use on all bearing surfaces	92-802854A1
	Clutch assembly keepers	
	Upper gear assembly	
	Upper shift cam	
	Lower gear assembly	
	Lower shift cam	
	Bearing (smaller OD)	
	Bearing (larger OD)	
	Bearing cup (smaller OD)	
	Yoke and shift cam assembly contact surfaces	
	Thrust bearing	
	Clutch assembly garter spring	
	Thrust bearing race	
	Bearings	
	Inside diameter of roller bearing	
	Shift assembly: ball detent canister	
Special Lubricant 101	Retainer nut	92-802865A1
	Inner diameter of screw recess	
	Compression spring and ball detent canister	
	Threads of retainer nut	
Loctite 277	Steel bearing adapter	Obtain locally
	Threads of steel bearing adapter	
Loctite 271 Threadlocker	Shifter shaft seal	92-809819
	First 2 or 3 threads of shift cam cap screw	
	Shift linkage cap screw	

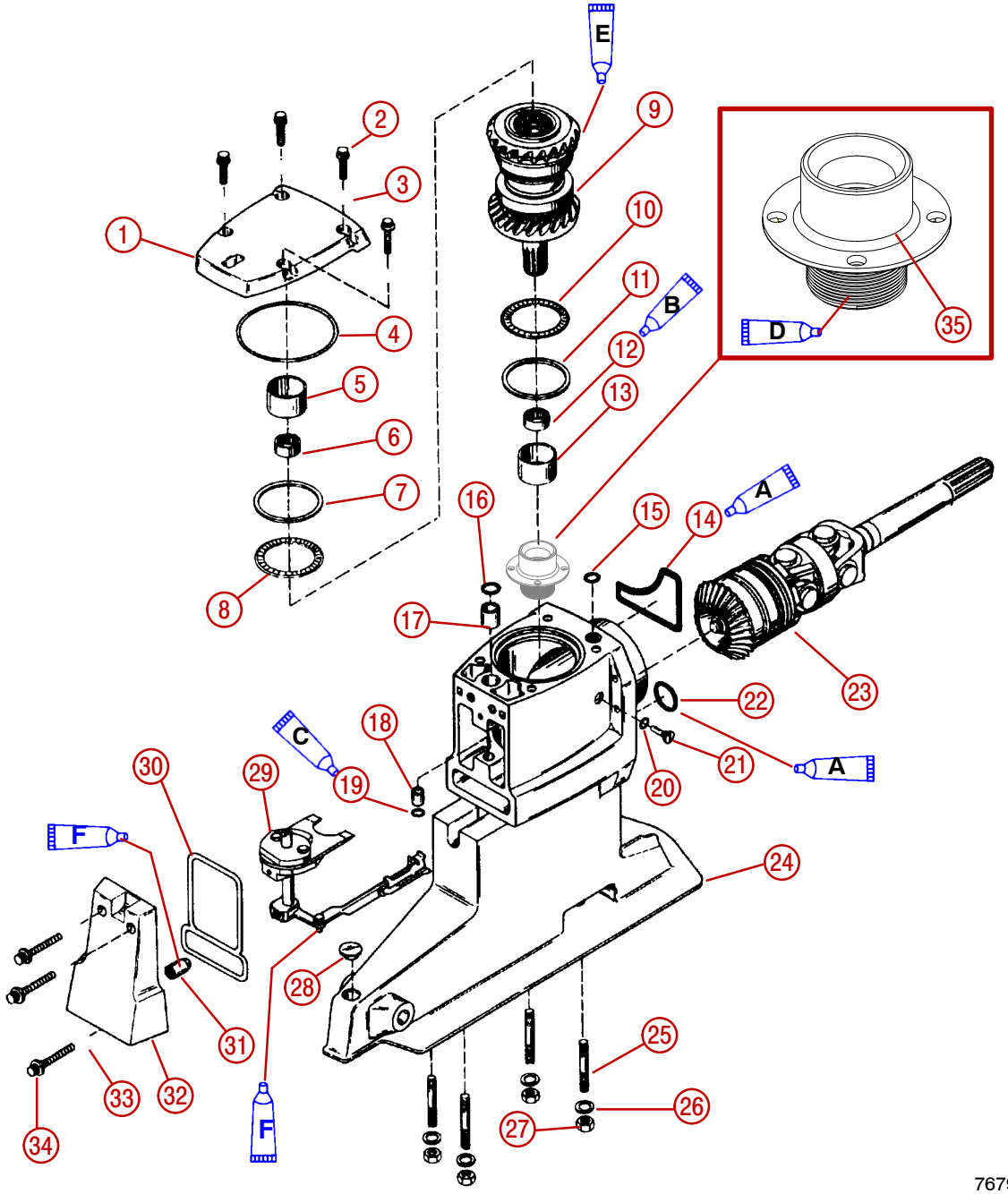
Lubricants / Sealants / Adhesives (continued)

Description	Where Used	Part Number
Bellows Adhesive	O-rings	92-86166Q1
60% Quicksilver High-Performance Gear Lube 40% Quicksilver Special Lubricant 101	Bottom face of bottom gear Top face of gear and thrust bearing	92-802854A1 92-802865A1
U-joint and Gimbal Bearing Grease	Cross and bearing	92-802870A1
Engine Coupler Spline Grease	U-joint assembly splines	92-802869A1
Exxon Unirex EP2 Grease	Cross and bearing O-rings	Obtain locally
2-4-C with Teflon	Lip of oil seal	92-802859A1
Needle Bearing Assembly Lubricant	Needle bearing	92-808868A1
Permalock 115	Socket screws	Obtain locally

NOTES:

Drive Shaft Housing Exploded View

Complete Housing

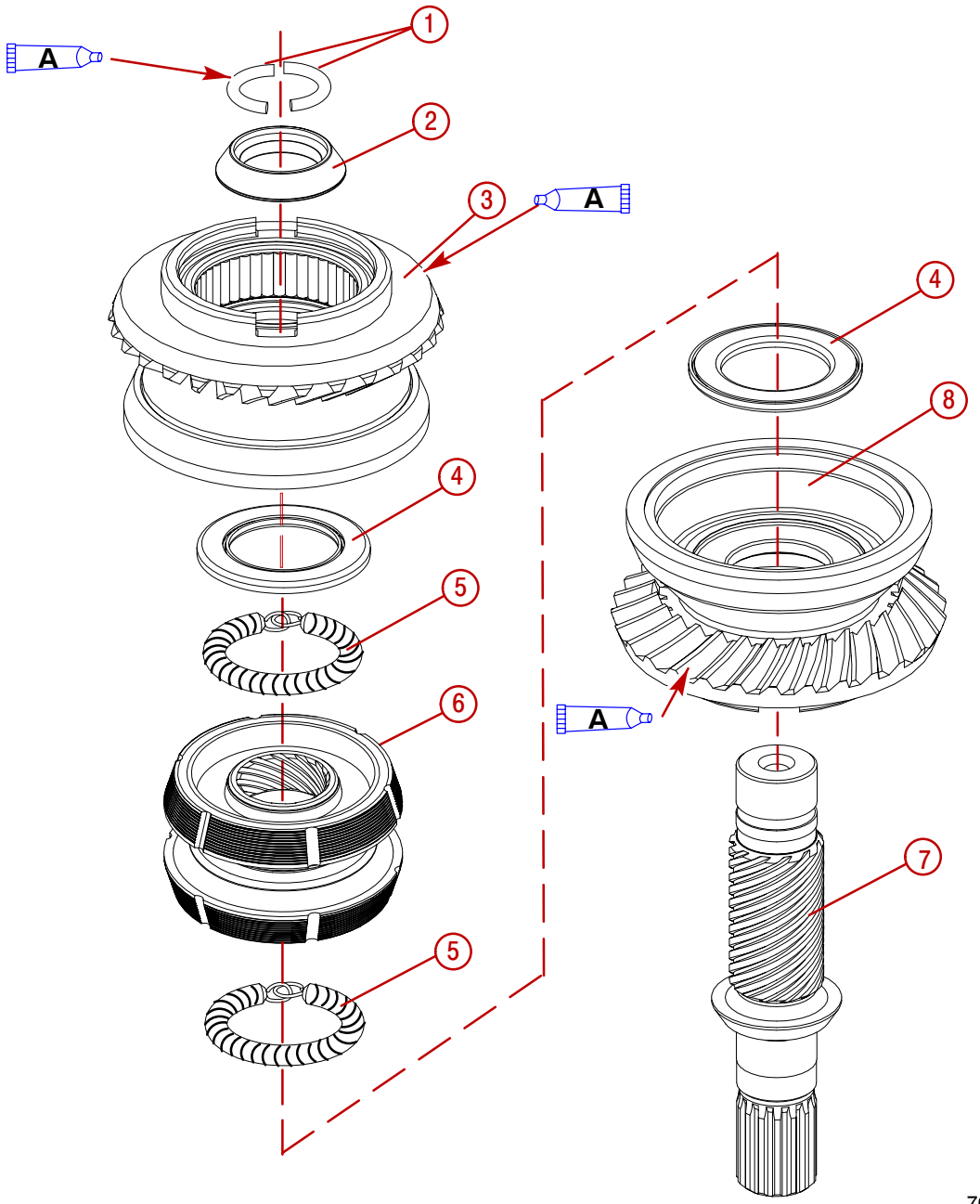


Complete Housing (continued)

1 - Top cover
2 - Screw (4)
3 - Flat washer (4) (not shown)
4 - O-ring
5 - Bearing sleeve
6 - Needle bearing
7 - Thrust race (shim)
8 - Thrust bearing
9 - Clutch assembly
10 - Thrust bearing
11 - Thrust race (shim)
12 - Needle bearing
13 - Bearing sleeve
14 - O-ring
15 - O-ring
16 - O-ring
17 - Shifter shaft bushing-upper
18 - Shifter shaft bushing-lower
19 - Shifter shaft seal
20 - Vent plug seal
21 - Vent plug
22 - O-ring
23 - U-joint assembly
24 - Drive shaft housing
25 - Stud (4)
26 - Flat washer (4)
27 - Locknut (4)
28 - Plastic plug
29 - Shifter assembly
30 - O-ring
31 - Ball detent canister
32 - Back cover
33 - Flat washer (3) (not shown)
34 - Screw (3)
35 - Steel bearing adapter (Only used for Bravo X, XZ, XR and Diesel Bravo)

Description		Where Used	Part Number
A	Bellows Adhesive	O-ring	92-86166Q1
B	Needle Bearing Assembly Lubricant	Needle bearing	92-808868A1
C	Loctite 271 Threadlocker	Shifter shaft seal	Obtain locally
D	Loctite 277	Steel bearing adapter	Obtain locally
E	High Performance Gear Lube	Use on all bearing surfaces	92-802854A1
F	Special Lubricant 101	Shift assembly: ball detent canister	92-802865A1

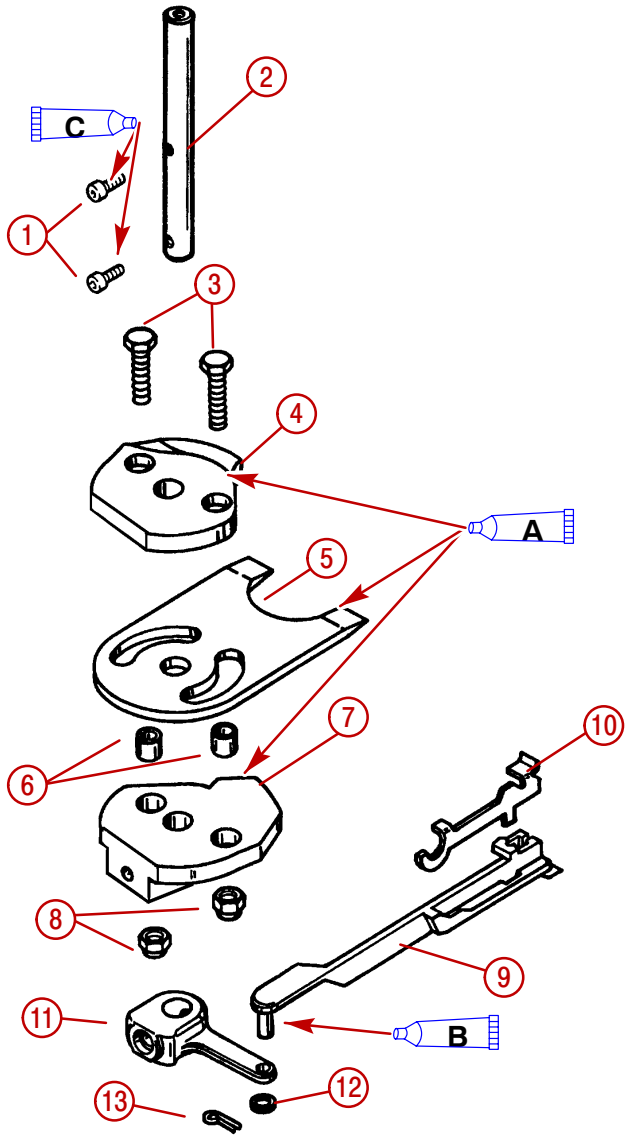
Clutch Assembly



1 - Keepers
2 - Collar
3 - Upper gear assembly
4 - Thrust bearings
5 - Garter springs
6 - Clutch
7 - Shaft
8 - Lower gear assembly

Description		Where Used	Part Number
A	High Performance Gear Lube	Clutch assembly keepers	92-802854A1
		Clutch upper gear assembly	
		Clutch lower gear assembly	

Shifter Assembly

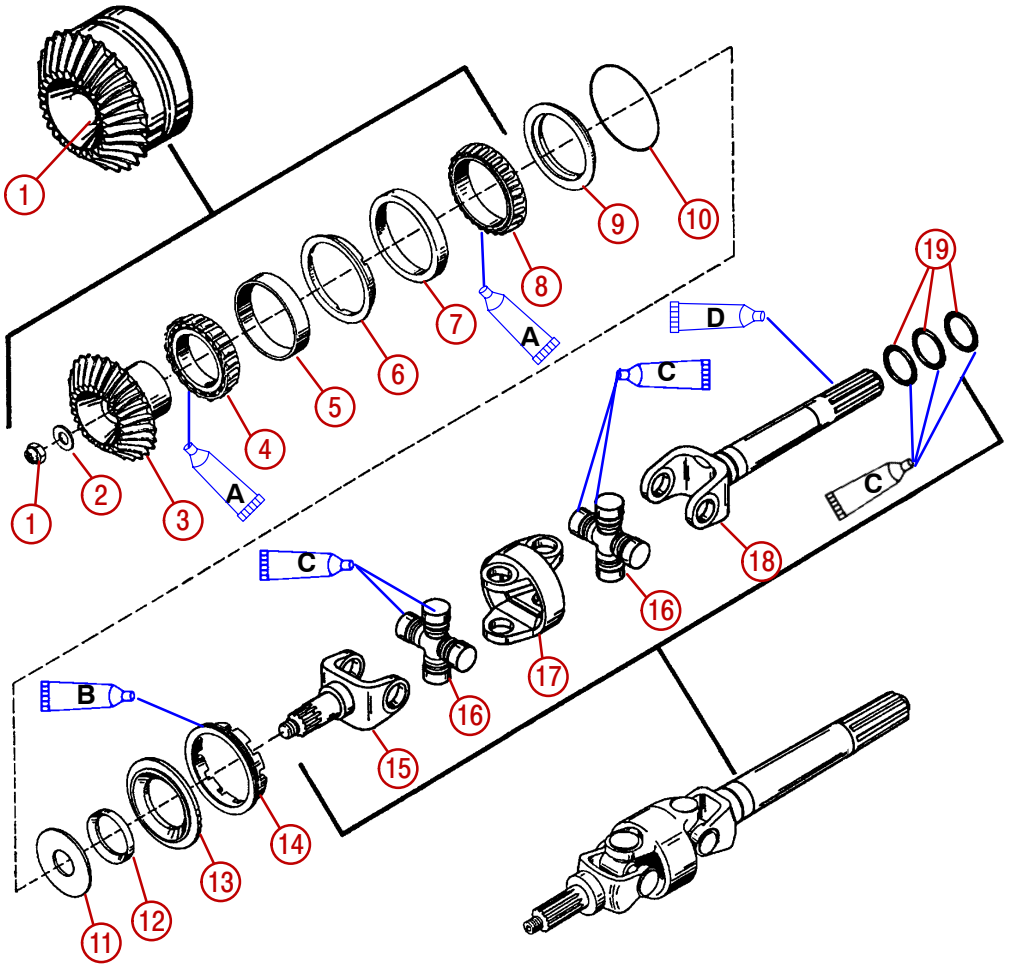


73363

1 - Socket screws
2 - Shifter shaft
3 - Screws
4 - Upper shift cam
5 - Yoke
6 - Spacers
7 - Lower shift cam
8 - Locknuts
9 - Link bar
10 - Latch
11 - Shift lever
12 - Flat washer
13 - Cotter pin

Description		Where Used	Part Number
A	High Performance Gear Lube	Upper shift cam	92-802854A1
		Lower shift cam	
B	Special Lubricant 101	Link bar	92-802865A1
C	Permalock 115	Socket screws	Obtain locally

Standard Bravo U-joint Assembly



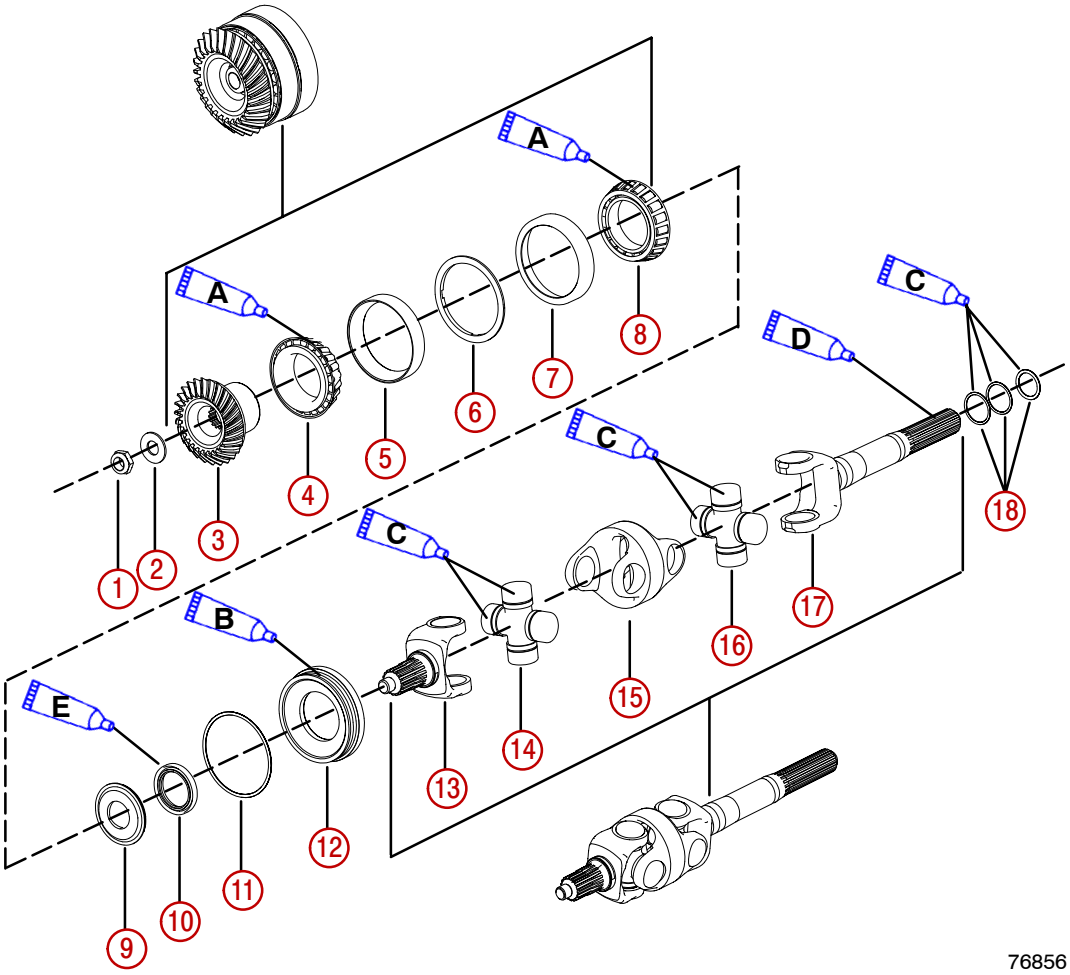
73364

1 - Locknut
2 - Washer
3 - Pinion gear
4 - Bearing (smaller OD)
5 - Bearing (smaller ID)
6 - Spacer
7 - Bearing cup (larger ID)
8 - Bearing larger OD)
9 - Sealing ring
10 - O-ring
11 - Beveled washer
12 - Oil seal
13 - Oil seal carrier
14 - Ring nut
15 - Yoke
16 - Cross and bearing
17 - Socket
18 - Yoke
19 - O-rings (3)

Description		Where Used	Part Number
A	High Performance Gear Lube	Bearing (smaller OD)	92-802854A1
		Bearing (larger OD)	
B	Special Lubricant 101	Ring nut	92-802865A1
C	U-joint and Gimbal Bearing Grease [1]	Cross and bearing	92-802870A1
		U-joint shaft O-rings	
D	Engine Coupler Spline Grease	U-joint splines	92-802869A1

1 Newer Bravo sterndrive units are fitted with non-regreasable U-joints.

Bravo X, XZ, XR and Diesel Bravo U-joint Assembly



1 - Locknut
2 - Washer
3 - Pinion gear
4 - Bearing cup (smaller OD)
5 - Bearing (smaller ID)
6 - Spacer
7 - Bearing cup (larger ID)
8 - Bearing larger OD)
9 - Thrust washer
10 - Oil seal
11 - O-ring
12 - Retainer nut
13 - Yoke
14 - Cross and bearing
15 - Socket
16 - Cross and bearing
17 - Yoke
18 - O-rings (3)

Description		Where Used	Part Number
A	High Performance Gear Lube	Bearing cup (smaller OD)	92-802854A1
		Bearing cup (larger OD)	
B	Special Lubricant 101	Retainer nut	92-802854A1
C	Exxon Unirex EP2 Grease[1]	Cross and bearing	Obtain locally
		O rings	
D	Engine Coupler Spline Grease	U-joint assembly splines	92-802869A1
E	2–4–C with Teflon	Oil seal	92-802859A1

1 Newer Bravo sterndrive units are fitted with non-regreasable U-joints.

Drive Shaft Housing and Gear Case Separation

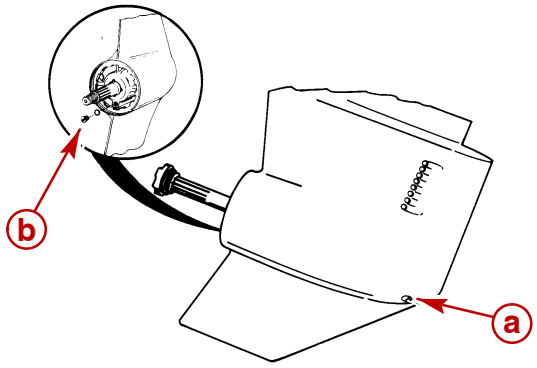
Sterndrive Unit Gear Ratio Identification

All sterndrive unit gear ratios are identified on each sterndrive unit in 2 places. It is important to note the ratio of the sterndrive unit before proceeding with any repairs. The first place to look is on the decal on the port side of the sterndrive housing. It will have a number such as “1.50R” (indicating a Bravo XR with a 1.5:1 gear ratio) and then the seal number. The second place to look will be on the universal joint splined yoke. It will be identified with a letter such as “F.” This method is explained in the following chart. This will be true for new or un-tampered-with sterndrive units. A sterndrive unit could have had the gear ratio changed for high altitude, which would void any application of the following charts. The gear ratio would then have to be determined by counting the teeth on the sterndrive gear and the driven gear in the drive shaft housing and using the following charts for reference.

⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

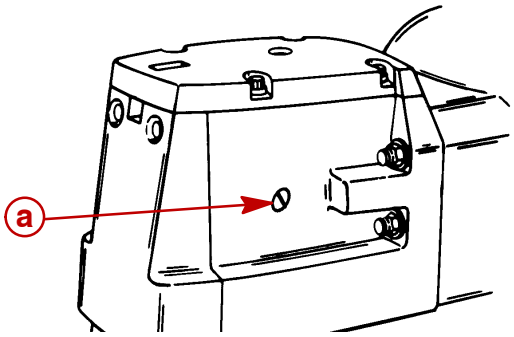
1. Remove, empty and clean gear lube monitor.
2. Drain sterndrive unit at location “**a**” or “**b**,” as applicable, by removing oil fill/drain screw.



22103

a - Oil fill/drain screw (Bravo Two and Three)
b - Oil fill/drain screw (Bravo One)

3. Remove oil vent screw.

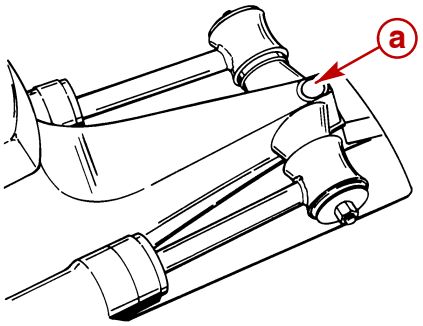


50072

a - Oil vent screw

4. **Bravo One, Bravo XZ, Bravo XR, and Diesel Bravo One X:**

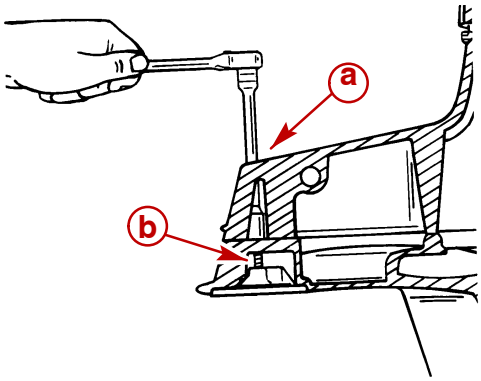
a. Remove rubber plug.



22093

a - Rubber plug

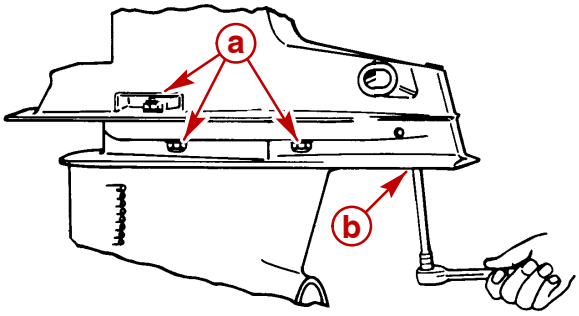
b. Remove anodic plate.



76800

a - Rubber plug
b - 1/2 in. bolt

c. Remove gear case from drive shaft housing.

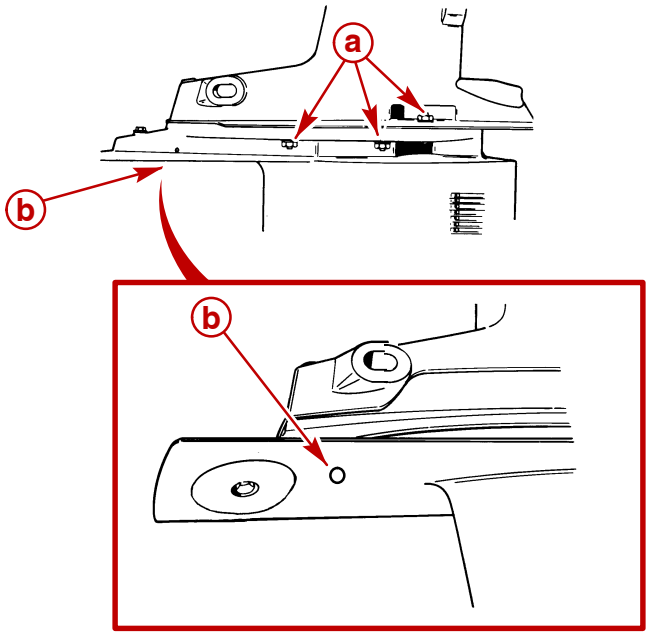


76801

a - 6 nuts and washers (3 each side)
b - Bolt (located in anodic cavity)

5. **Bravo Two and Diesel Bravo Two X:**

   a. Remove gear case from drive shaft housing.

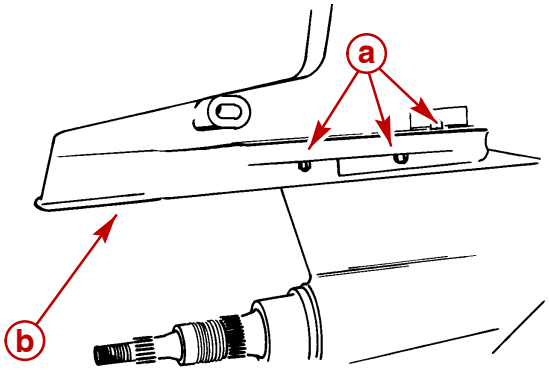


76802

a - 6 nuts and washers (3 each side)
b - Bolt

6. **Bravo Three and Diesel Bravo Three X:**

   a. Remove gear case from drive shaft housing.

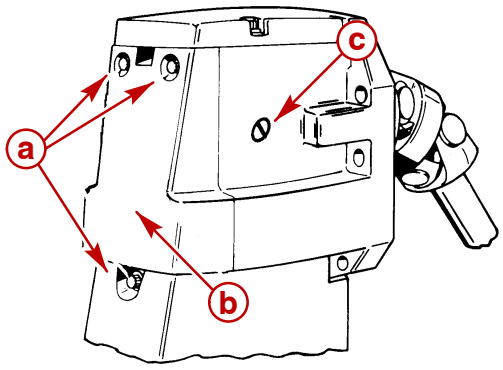


76803

a - 6 nuts and washers (3 each side)
b - Bolt (located in anodic plate cavity)

Drive Shaft Housing Disassembly

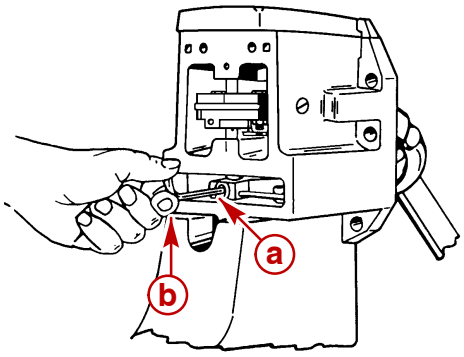
1. Shift sterndrive unit to the NEUTRAL detent position.
2. Remove rear cover by removing screws. Ensure vent screw is removed.



76805

a - Screws
b - Rear cover
c - Vent hole

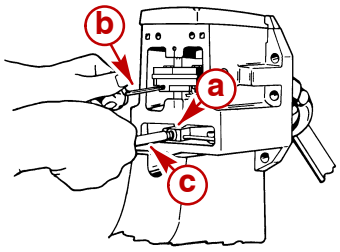
3. Remove shift linkage cap screw.



76806

a - Shift linkage cap screw
b - Hex wrench

4. Install shift handle tool into shift lever and shifter shaft to aid in removing shift cam cap screw.

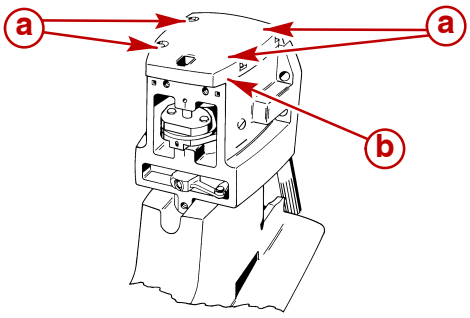


76807

a - Shift cam cap screw
b - Hex wrench
c - Shift Handle Tool

Shift Handle Tool		
73357	Positions and removes the shifter shaft on the Bravo One and Bravo Two sterndrive units.	91-17302

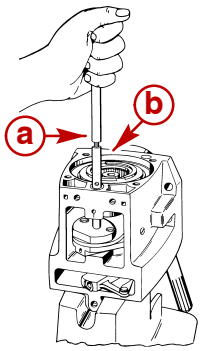
5. Remove bolts and lift top cover.



76835

a - Bolts (4)
b - Cover

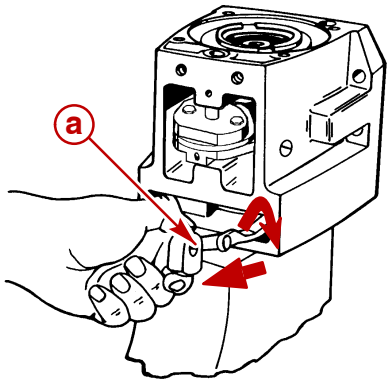
6. Lift shaft straight out.



76836

a - Shift Handle Tool
b - Shifter shaft

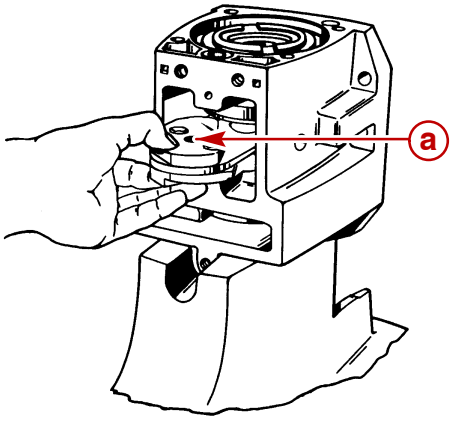
7. Remove shift linkage assembly.
   a. Rotate link bar 1/4 turn CLOCKWISE.
   b. Pull linkage assembly out. If linkage binds; move assembly from side to side while pulling.



76837

a - Shift linkage

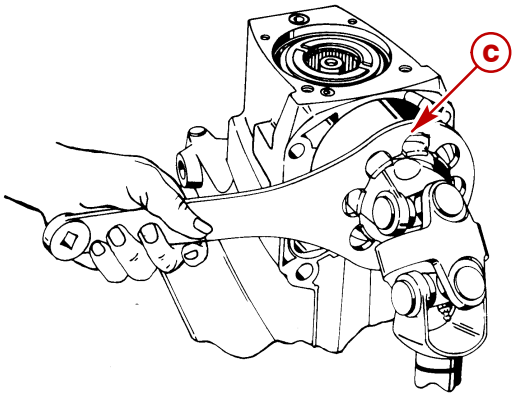
8. Remove yoke and cam assembly.



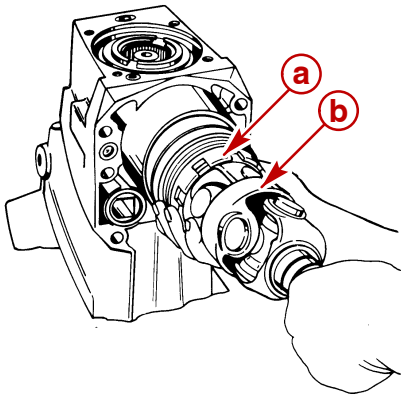
76838

a - Yoke and cam assembly

9. Loosen retainer nut and remove pinion and U-joint assembly using U-joint retainer wrench.

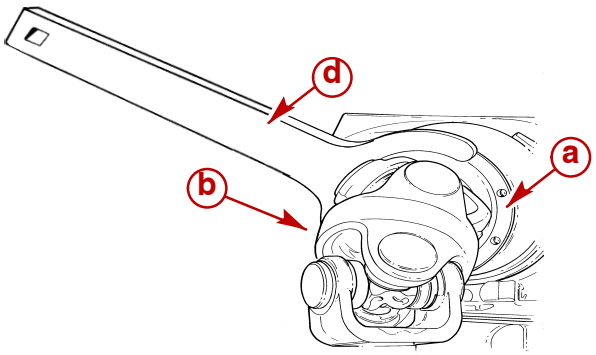


76839



76840

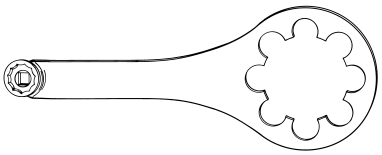
Standard Bravo

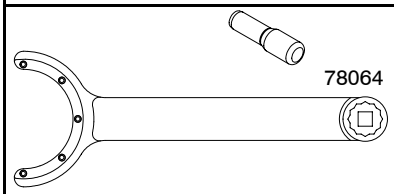


77077

Bravo XZ, XR, and Diesel Bravo

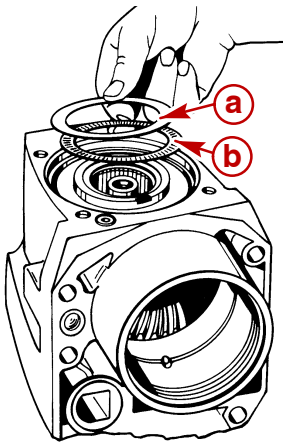
a - Retainer nut
b - U-joint
c - Bearing Retainer Wrench
d - Spanner Wrench For L-18 U-joint Bearing Retainer

Bearing Retainer Wrench		
 73482	Installs and removes the drive shaft bearing retainer on the Blackhawk and all Mercury MerCruiser Bravo sterndrive units, excluding the Bravo X series.	91-17256

Spanner Wrench For L-18 U-joint Bearing Retainer		
 78064 78065	Installs and removes the drive shaft bearing retainer on the Bravo XZ and XR sterndrive units. 91-862218 Replacement pins (5)	91-862219A1

NOTE: *In steps 10 and 12, note the proper order and position of thrust races, thrust bearings, and clutch assembly for later reassembly.*

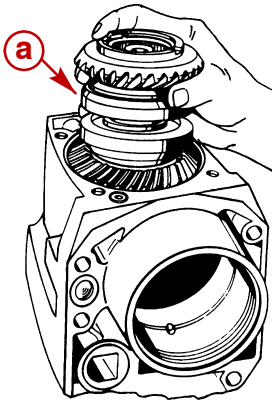
10. Remove upper thrust race (shim) and thrust bearing.



76841

a - Upper thrust race
b - Thrust bearing

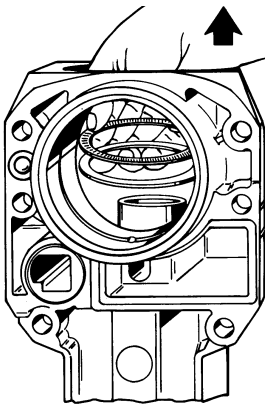
11. Remove clutch and gear assembly.



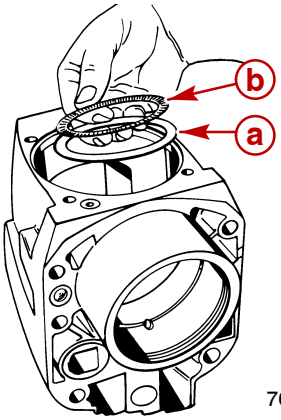
76842

a - Clutch and gear assembly

12. Remove lower thrust race (shim) and thrust bearing.



50341

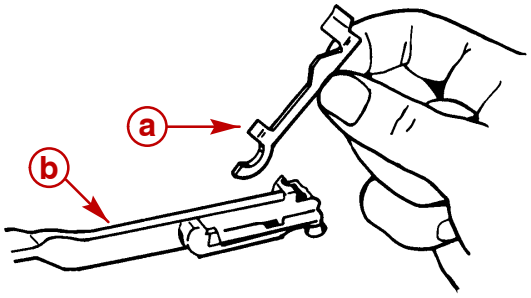


76841

a - Lower thrust race
b - Thrust bearing

Shifter Repair

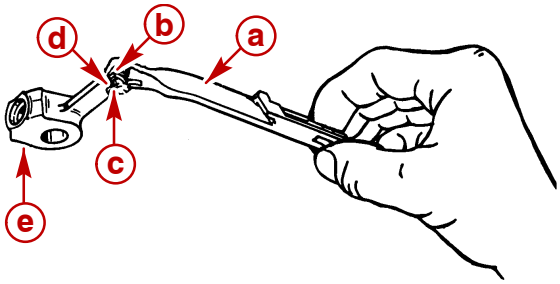
1. Remove latch from link bar.



22100

a - Latch
b - Link bar

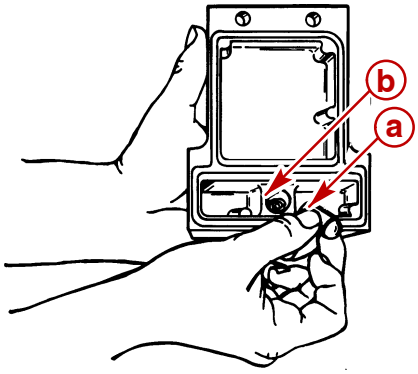
2. Remove link bar from shift lever. Discard cotter pin.



22099

a - Link bar
b - Cotter pin
c - Clevis pin
d - Washer
e - Shift lever

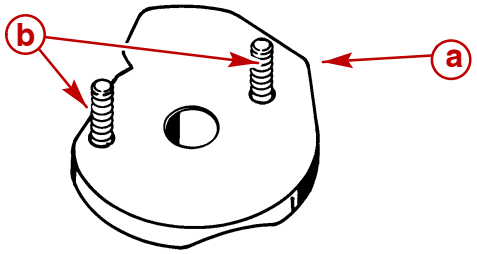
3. Remove ball detent canister and compression spring.



22100

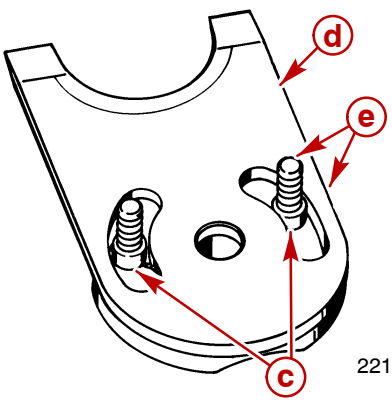
a - Ball detent canister
b - Compression spring

4. Disassemble yoke and cam assembly.

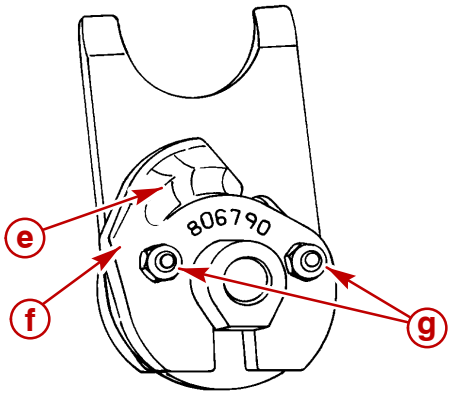


22101

a - Shift cam
b - Bolts



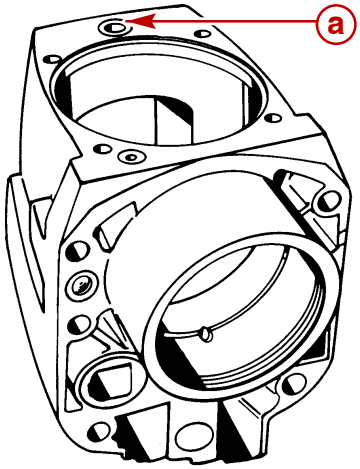
22101



75221

c - Spacers
d - Yoke
e - Contact surface
f - Shift cam
g - Locknuts

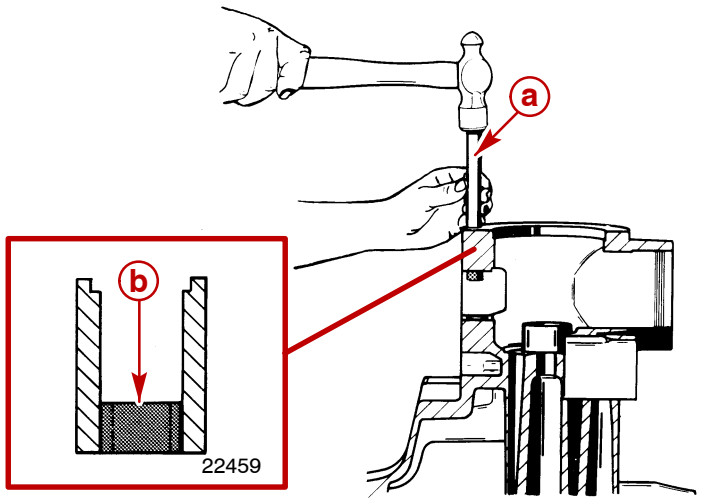
5. Remove shifter shaft upper O-ring.



76843

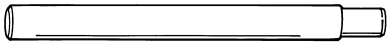
a - O-ring

6. Remove shifter shaft upper bushings using Bushing Removal Tool.

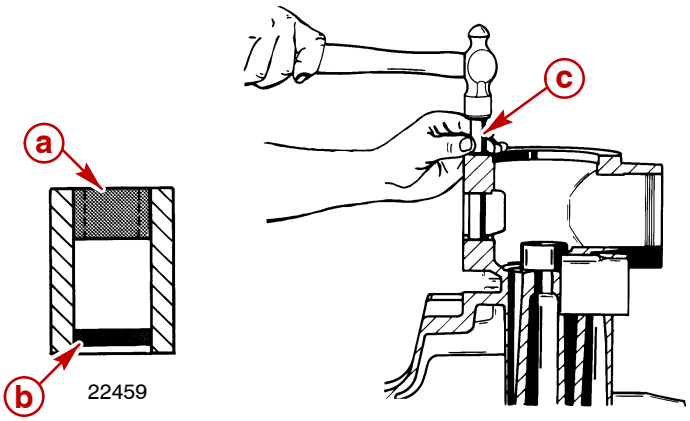


22223

a - Bushing Removal Tool
b - Bushing

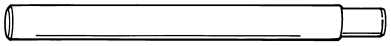
Bushing Removal Tool		
 73432	Removes the shifter shaft bushings on all the Bravo sterndrive units.	91-17273

7. Remove shifter shaft lower bushing and oil seal using Bushing Removal Tool.



22223

a - Shifter shaft lower bushing
b - Oil seal
c - Bushing Removal Tool

Bushing Removal Tool		
 73432	Removes the shifter shaft bushings on all the Bravo sterndrive units.	91-17273

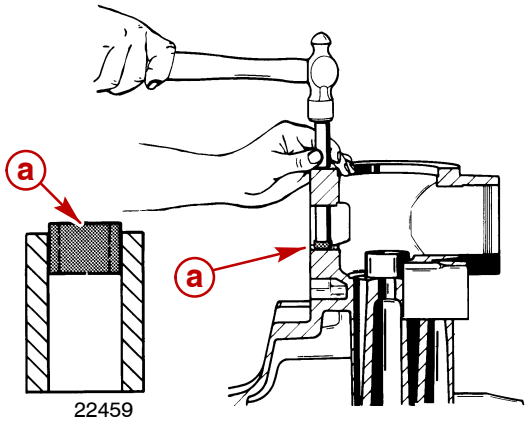
Shifter Inspection

NOTE: *Refer to Drive Shaft Housing Exploded View.*

1. Inspect shift link bar and shift lever for:
   - Damaged or bent parts
   - Worn jaw area
   - Excessively worn detent area on shift lever
2. Inspect ball detent canister for:
   - Broken springs
   - Ball out of canister
3. Inspect yoke and cam assembly for:
   - Damaged cam spacers
   - Excessively worn cam surface
4. Inspect shifter shaft for:
   - Excessive wear in area where bushings make contact (bushings must be replaced if replacing shifter shaft)
5. Inspect shifter shaft bushing for:
   - Excessive wear
   - Knicks and scratches (shifter shaft must be replaced if replacing bushings)
6. Inspect shifter shaft upper O-ring for:
   - Cuts and knicks
   - Flat spots (from being compressed)
7. Inspect shifter shaft lower oil seal for:
   - Cuts or knicks

Shifter Reassembly

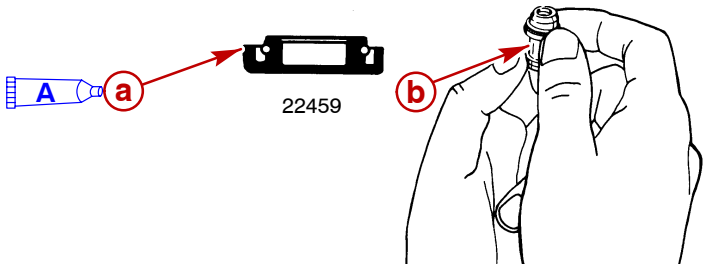
1. Install shifter shaft lower bushing and oil seal as follows:
   a. Install lower bushing part way into bore as shown.



22459 22223

a - Lower bushing

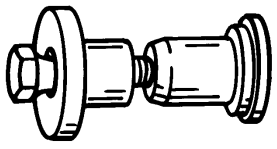
   b. Place oil seal onto Bearing And Seal Installation Tool with lip of seal facing upward. Apply sealant to outside diameter of seal before installation.



22459 22263

a - Oil seal
b - Bearing And Seal Installation Tool

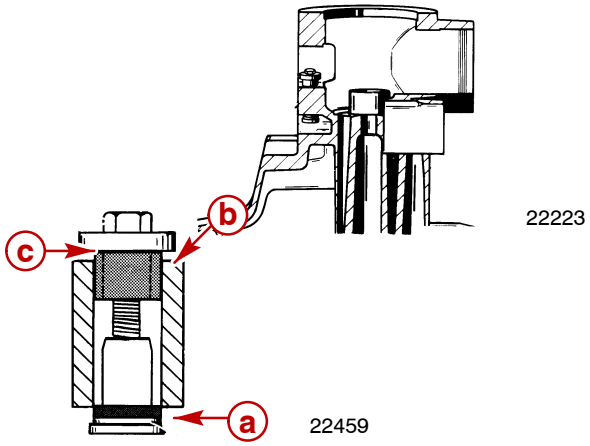
Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Outside diameter of seal	92-809819

Bearing and Seal Installation Tool		
 73464	Installs the shifter shaft bushings on all the Bravo and Blackhawk sterndrive units.	91-17275A1

c. Place Bearing And Seal Installation Tool with oil seal into bore from bottom.

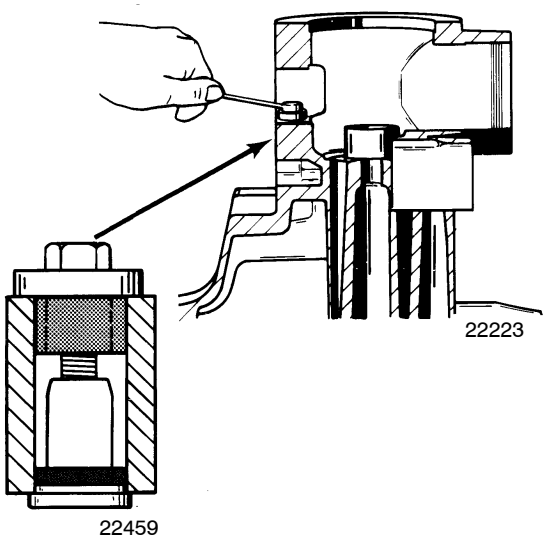
d. Place screw pilot through bushing from top.

e. Install screw through screw pilot and into Bearing And Seal Installation Tool.



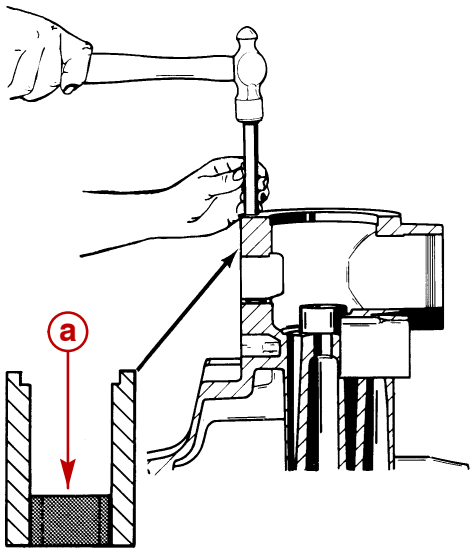
a - Bearing And Seal Installation Tool
b - Screw pilot
c - Screw

f. Pull oil seal and bushing into place by turning screw CLOCKWISE until tool contacts the casting.



g. Loosen screw and remove tool.

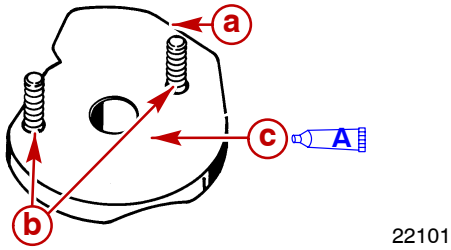
2. Install shifter shaft upper bushings as follows:
   a. Install bushing into bore so that bushing is flush with bottom of bore.



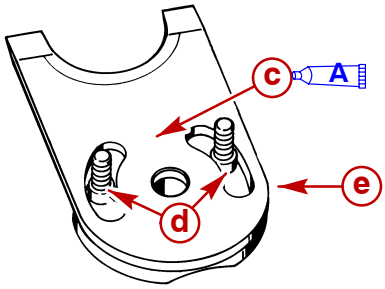
22459 22223

a - Bushing

3. Assemble yoke and shift cam assembly.
4. Coat contact surfaces with lubricant.



22101

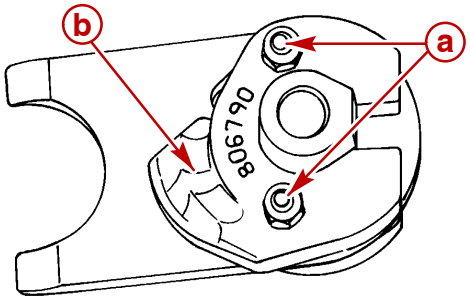


22101

a - Shift cam
b - Bolts
c - Contact surface
d - Spacers
e - Yoke

Description		Where Used	Part Number
A	High Performance Gear Lube	Yoke and shift cam assembly contact surfaces	92-802854A1

5. Torque locknuts.



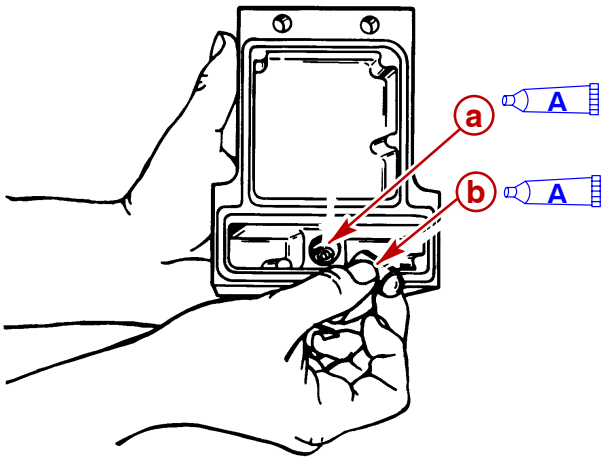
75221

Shifter assembly

a - Locknuts
b - Shift cam

Description	Nm	lb-in.	lb-ft
Shift assembly locknuts	9	80	

6. Apply small amount of lubricant to compression spring and ball detent canister and install into rear cover.

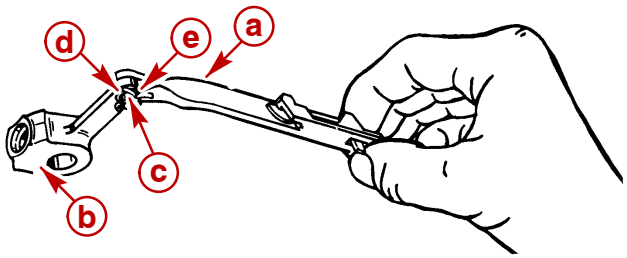


22100

a - Compression spring
b - Ball detent canister

Description		Where Used	Part Number
A	Special Lubricant 101	Compression spring and ball detent canister	92-802865A1

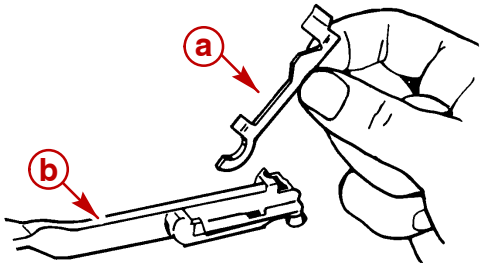
7. Install link bar to shift lever. Install cotter pin and spread ends.



22099

a - Link bar
b - Shift lever
c - Clevis pin
d - Washer
e - Cotter pin

8. Install latch on link bar.



22100

a - Latch
b - Link bar

U-joint and Pinion Gear

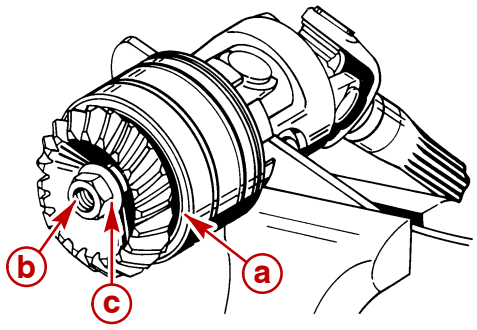
The following Bravo sterndrive units are equipped with Permalube non-regreasable U-joints.	
Dual Water Pickup 1.5:1	0M160890 - Current
Dual Water Pickup 1.36:1	0M130898 - Current
Dual Water Pickup 1.50:1	0M161523 - Current
Dual Water Pickup 1.65:1	0M168818 - Current
Bravo One 1.5:1	0M111208 - Current
Bravo Two 1.5:1	0M158602 - Current
Bravo Two 2.0:1	0M133422 - Current
Bravo Two 2.2:1	0M163866 - Current
Bravo Three 1.5:1	0M141102 - Current
Bravo Three 1.65:1	0M171803 - Current
Bravo Three 1.81:1	0M159838 - Current
Bravo Three 2.0:1	0M166042 - Current
Bravo Three 2.2:1	0M150340 - Current
Bravo Three 2.43:1	0M129436 - Current

Inspection

1. Inspect pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. If any of these conditions exist, it will be necessary to replace complete sterndrive gear and bearing assembly.
2. Rotate bearings on pinion gear by hand. Rough, uneven movement, or a loose condition indicates need for replacement. If sterndrive gear is in good condition, it will be necessary to replace bearings only.
3. Inspect U-joints for a loose or rough movement and deteriorated seals. If any of these conditions exist, replace cross and bearing assembly.

Disassembly

1. Remove nut and washer from U-joint shaft and remove sterndrive gear and bearings as an assembly. Remove remaining components.



76861

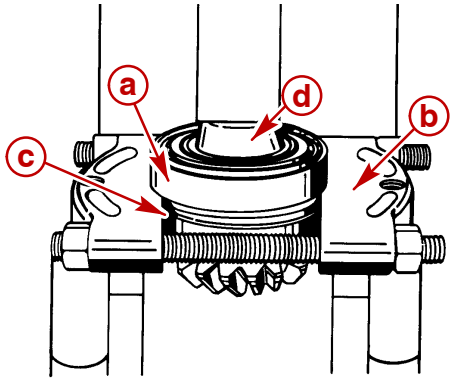
Standard Bravo shown

a - Sterndrive gear and bearing assembly
b - Nut
c - Washer

⚠ CAUTION

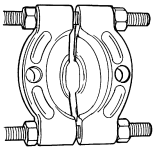
Do not damage spacer when removing first bearing from pinion gear. Spacer must be used in reassembly.

2. If the U-joint bearings are in need of replacement and the gear is in good condition, remove the bearings from the gear using a puller plate and arbor press (bearings are damaged in removal and should not be reused).



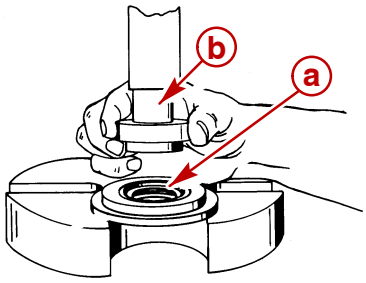
22393

a - Gear and bearing assembly
b - Universal Puller Plate
c - Spacer
d - Suitable mandrel

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

3. If seal is defective, remove U-joint seal using a punch and hammer or press out with suitable mandrel.

NOTE: *The U-joint seal is located in the seal carrier on standard Bravo sterndrives and in the bearing retainer nut on Bravo X, XZ, XR, and Diesel Bravo.*



22102

Standard Bravo shown

a - Seal
b - Suitable mandrel

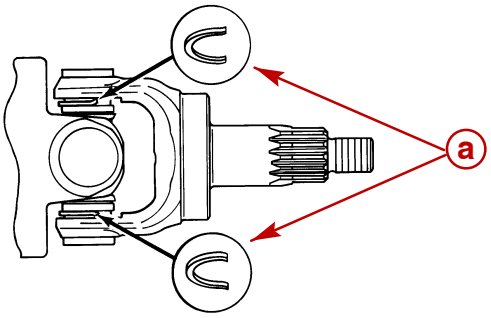
4. If replacing U-joint cross bearings, proceed as follows:

IMPORTANT: Do not place U-joint in a vise; place press in vise while removing bearing.

⚠ WARNING

U-joint snap rings might accidentally be knocked off of the U-joint during installation. Wear safety glasses to avoid eye injury.

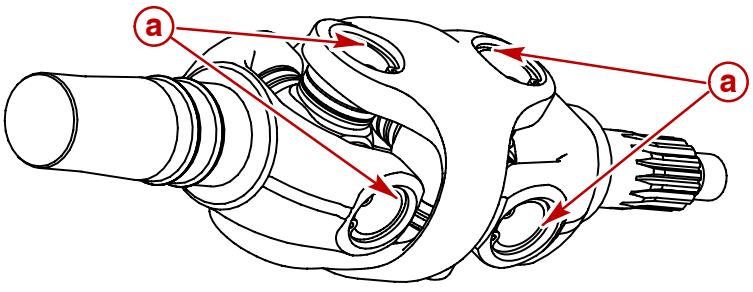
a. Remove U-joint bearing snap rings.



22179

Standard U-joint

a - Snap ring



78987

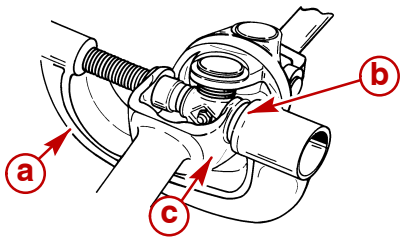
Permalube U-joint

a - Snap ring

b. Using U-joint adapter and press, press one bearing in until opposite bearing is pressed out into adapter. Remove loose bearing.

NOTE: *Bravo X series does not require the U-joint adapter.*

NOTE: *Permalube bearings can be pressed using a suitable mandrel.*



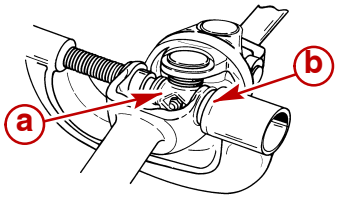
22180

a - U-joint press
b - U-joint adapter
c - Yoke

c. Turn U-joint assembly 180 degrees and press on bearing cross to remove second bearing.

d. Remove second bearing.

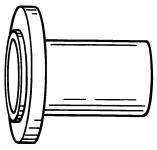
e. Remove each pair of bearings in this manner.



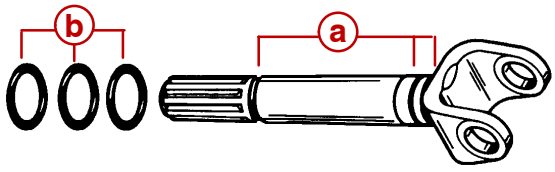
22180

a - Bearing cross
b - U-joint Adapter

Description	Part Number
U-joint press	CJ 91D

U-joint Adapter		
 74229	Supports the yoke when disassembling the U-joint on all the Mercury MerCruiser sterndrive units, excluding the Bravo X series.	91-38756

5. Remove 3 O-rings from coupling end of U-joint shaft.



73922

a - O-ring grooves
b - O-rings

Reassembly

⚠ CAUTION

Use only Quicksilver U-joint and Gimbal Bearing Grease for lubricating sterndrives with regreasable U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

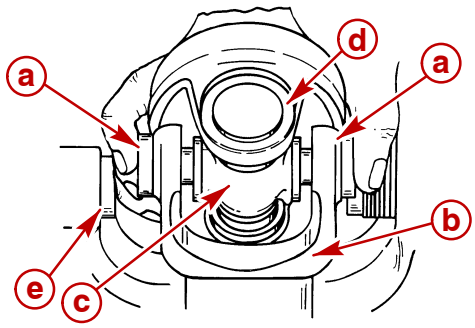
⚠ WARNING

U-joint snap rings might accidentally be knocked off of the u-joint during installation. Wear safety glasses to avoid eye injury.

1. Reassemble U-joints as follows:
   a. Position crosses in yoke. For standard U-joint, ensure that grease fittings are facing to coupler yoke (longer yoke).
   b. Place U-joint bearing cups in yoke and start them on bearing cross members. Install by using adapter and pressing bearing through yoke and onto cross members.

NOTE: *Bravo X series does not require the U-joint adapter.*

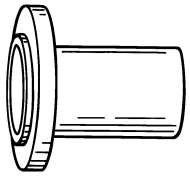
NOTE: *Permalube cross bearings can be pressed using a suitable mandrel.*



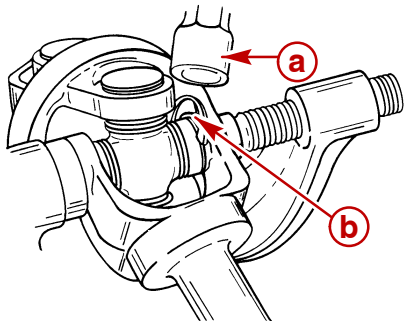
22181

Standard Bravo sterndrive

- **a** - Bearings
- **b** - Yoke
- **c** - Cross members
- **d** - Grease fitting (facing longer yoke) if equipped
- **e** - U-joint Adapter

U-joint Adapter		
 74229	Supports the yoke when disassembling the U-joint on all the Mercury MerCruiser sterndrive units, excluding the Bravo X series.	91-38756

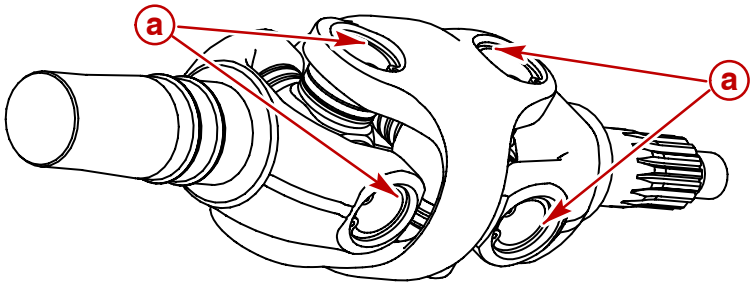
c. Install bearing cup retaining snap rings.



22182

Standard U-joint

a - Hammer
b - Snap ring



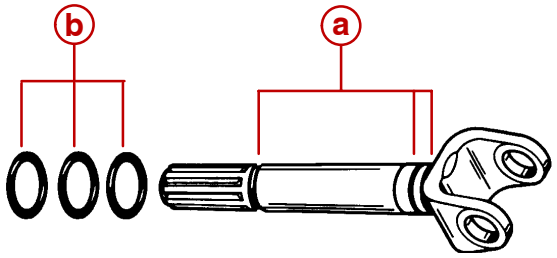
78987

Permalube U-joint

a - Snap ring

d. Install each pair of bearings in this manner.

2. Install 3 new O-rings on coupling end of U-joint shaft.

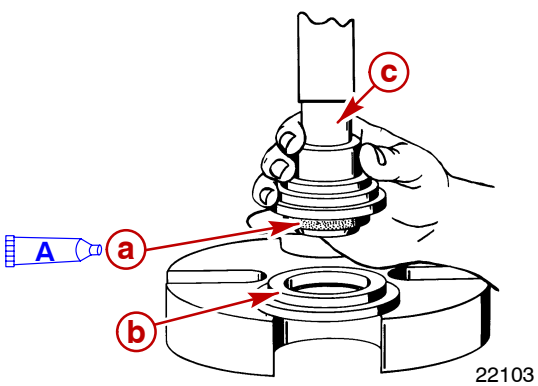


73922

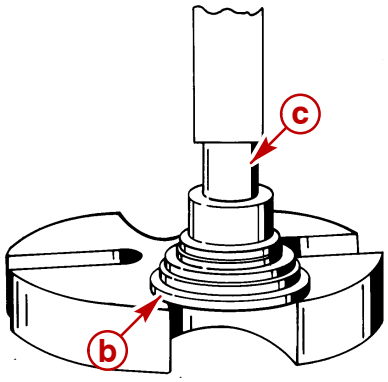
a - O-ring grooves
b - O-rings

3. Coat outside diameter of oil seal with sealant and press oil seal in with lip of seal facing pinion gear, using bearing driver until tool contacts the carrier.

NOTE: *The U-joint seal is located in the seal carrier on standard Bravo sterndrives and in the bearing retainer nut on Bravo X, XZ, XR, and Diesel Bravo.*



22103

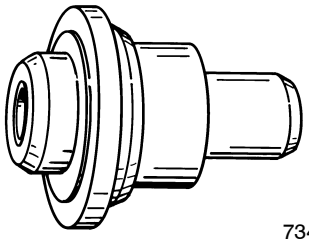


22103

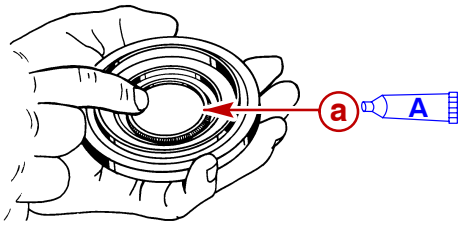
Standard Bravo shown

a - Oil seal
b - Oil seal carrier
c - Seal driver

Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Outside diameter of oil seal	92-809819

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

4. Lubricate lip of oil seal.

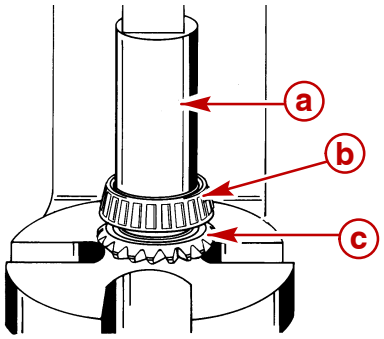


22435

a - Oil seal lip

Description		Where Used	Part Number
A	2-4-C with Teflon	Lip of oil seal	92-802859A1

5. If tapered roller bearings were removed from pinion gear, replace as follows.
   a. Press smaller outside diameter bearing onto pinion gear using bearing installation tool.



22393

a - Suitable mandrel
b - Bearing - smaller O.D.
c - Pinion gear

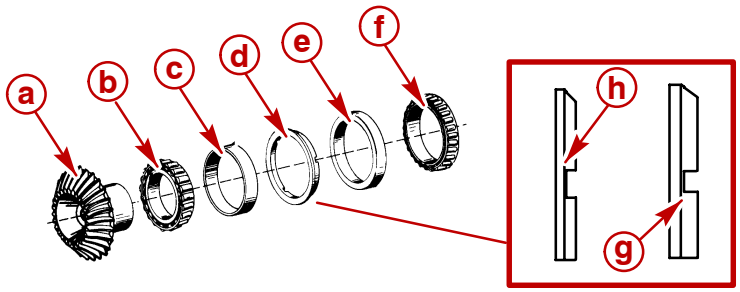
⚠ CAUTION

If spacer is not installed correctly in next step, severe damage to the sterndrive unit will result during reassembly.

b. Place smaller outside diameter cup over bearing pressed on in step “a”.

c. Install spacer (flat face toward gear).

d. Install larger outside diameter bearing cup.

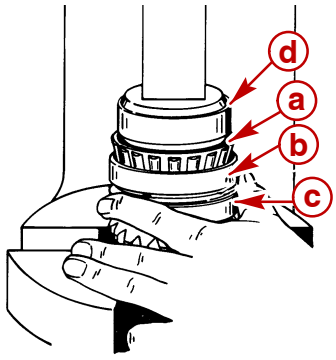


76844

a - Pinion gear
b - Smaller outside diameter bearing (first)
c - Smaller outside diameter cup (second)
d - Spacer - wider face toward gear (third)
e - Larger outside diameter bearing cup (fourth)
f - Larger outside diameter bearing (fifth)
g - Standard Bravo - spacer 0.250 in. (6.35 mm) thick
h - Bravo X, XZ, XR, and Diesel Bravo - spacer 0.210 in. (5.36 mm) thick

IMPORTANT: Spacer between bearing cups must free to move. Do not over press as damage to both bearings could occur.

e. Press larger outside diameter bearing onto gear. Press bearing to the point where bearing rollers initially make contact with tapered bearing cup.



22393

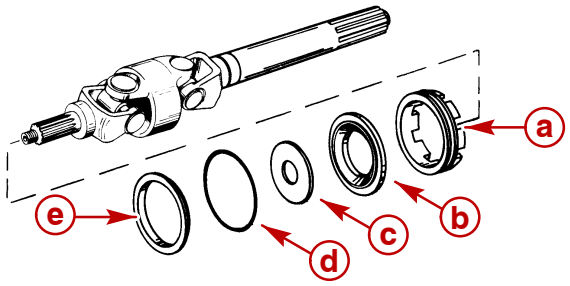
a - Bearing – larger outside diameter
b - Larger outside diameter bearing cup
c - Spacer – must move freely
d - Suitable mandrel – must push on inner bearing race

NOTE: *If a slight over press condition occurs (spacer does not move freely), support large OD bearing cup with universal puller plate and lightly tap end of pinion gear with a soft hammer. Failure to do this can result in premature bearing failure.*

⚠ CAUTION

U-joint and pinion gear assembly must be reassembled as shown in following steps or damage to sterndrive unit will occur during reassembly.

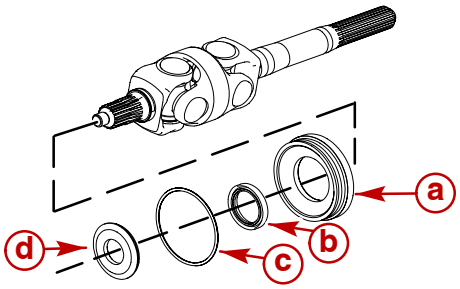
6. Install the components.



22249

Standard Bravo

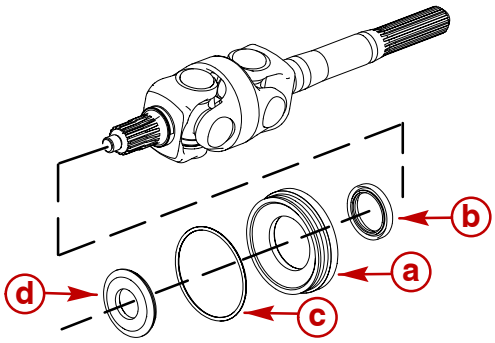
a - Retainer nut (threaded end toward pinion gear)
b - Oil seal carrier (lip of seal facing pinion gear)
c - Large washer (taper facing U-joints)
d - O-ring (between oil seal carrier and sealing ring)
e - Sealing ring (taper facing U-joints)



76845

Bravo XZ and XR

a - Retainer nut (threaded end toward pinion gear)
b - Oil seal (lip of seal facing pinion gear)
c - O-ring (on retainer nut)
d - Thrust washer (taper facing U-joints)

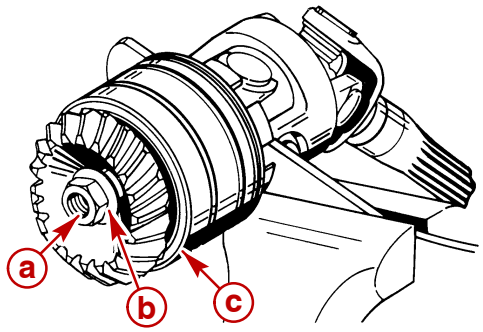


78921

Bravo X and Diesel Bravo

a - Retainer nut (threaded end toward pinion gear)
b - Oil seal (lip of seal facing pinion gear)
c - O-ring (on retainer nut)
d - Thrust washer (taper facing U-joints)

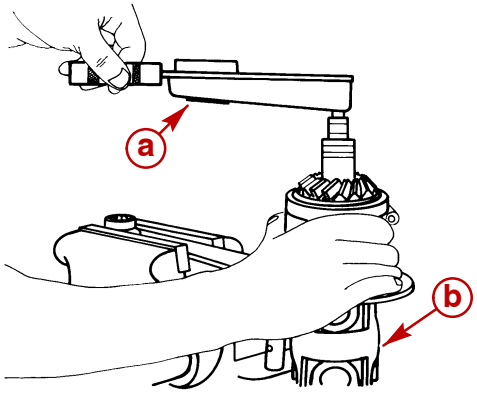
7. Secure pinion gear assembly to shaft with washer and new nut. Tighten nut to the point where washer just touches gear.



22102

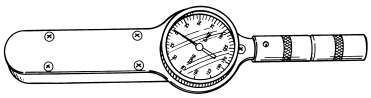
a - Nut
b - Washer
c - Pinion gear assembly

8. Set the preload on bearing package as follows:
   a. Mount retainer wrench in vise to support U-joint assembly.
   b. Position U-joint assembly so that shaft is pointing straight down.



70212

a - Torque wrench (lb-in.)
b - U-joint shaft (hanging straight down)

Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

   c. Apply a light coat of lubricant to bearings.

Description	Where Used	Part Number
High Performance Gear Lube	Bearings	92-802854A1

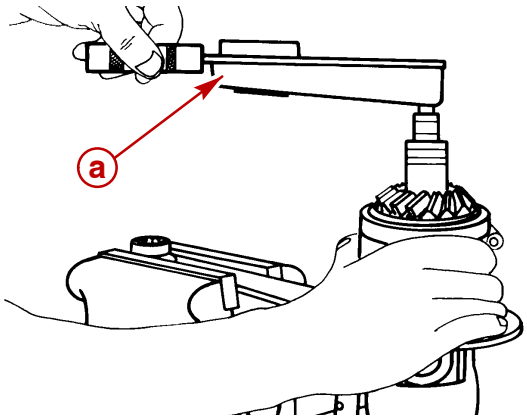
d. Set preload by tightening nut 1/16 of a turn at a time.

e. Check for proper preload by turning pinion gear, using an extension, appropriate socket, and torque wrench (lb-in. - with dial indicator), until acceptable torque is obtained. (Refer to **Torque Specifications** for **Torque Wrench Conversion Chart**.)

f. If nut becomes over tightened (causing excessive preload), loosen nut a number of turns and lightly strike pinion end of U-joint shaft using a soft hammer. Repeat procedure.

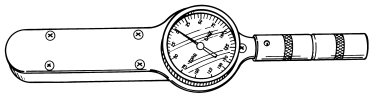
Description	New	Used*
U-joint Bearings	0.7-1.0 Nm (6-10 lb-in.)	0.3-0.8 Nm (3-7 lb-in.)

Description	Nm	lb-in.	lb-ft
Pinion gear nut	0.7-1.1	6-10	



Standard Bravo shown

a - Torque wrench (lb-in. – dial indicator)

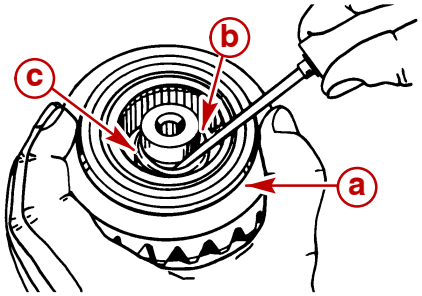
Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

Gear Disassembly, Inspection and Reassembly

NOTE: *Note the proper order an position of thrust races, thrust bearings, and clutch assembly, if assembly components are to be replaced.*

Disassembly

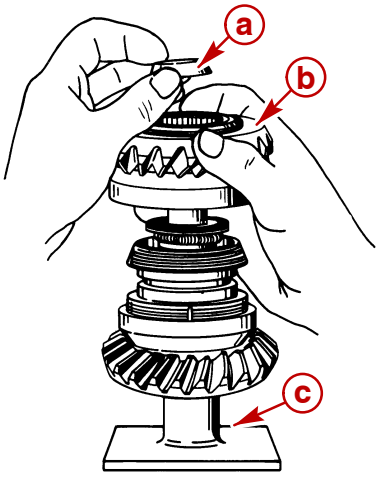
1. Remove keepers by pressing down on gear and turning CLOCKWISE to release keepers and collar.



22105

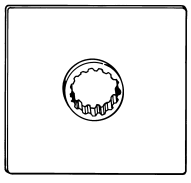
a - Top gear
b - Thrust collar
c - Keepers (2)

2. Remove thrust collar and gear from shaft.

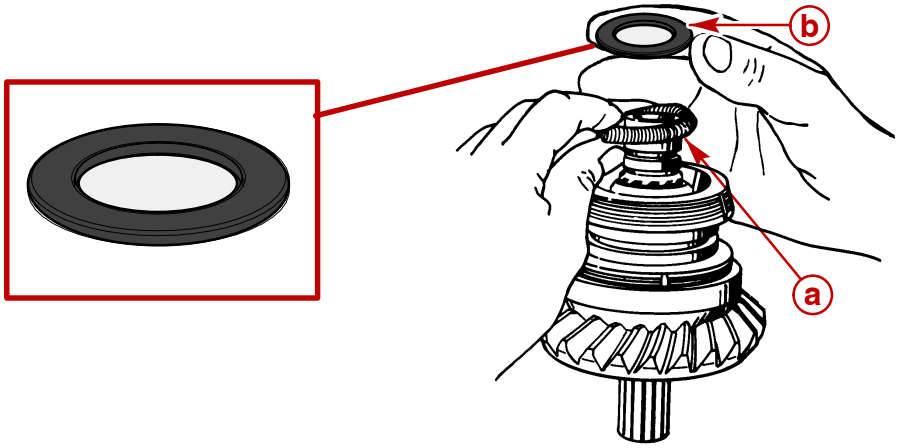


76847

a - Thrust collar
b - Top gear
c - Clutch Assembly Stand

Clutch Assembly Stand		
 73434	Holds the Bravo and Blackhawk clutch assemblies for servicing.	91-17301T1

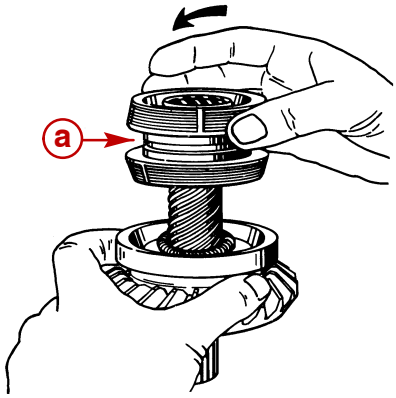
3. Remove thrust bearing and garter spring.



76862

a - Thrust bearing
b - Garter spring

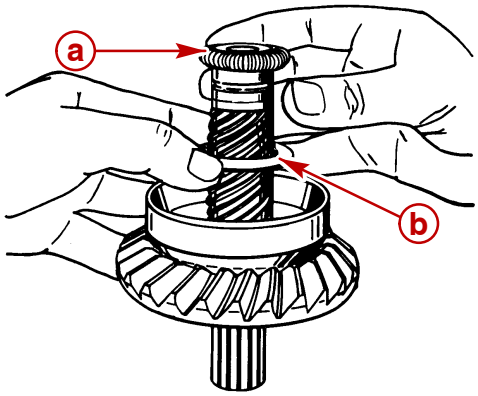
4. Twist clutch COUNTERCLOCKWISE while pulling up to separate clutch from shaft.



22106

a - Clutch

5. Remove lower garter spring and thrust bearing.



76848

a - Garter spring
b - Thrust bearing

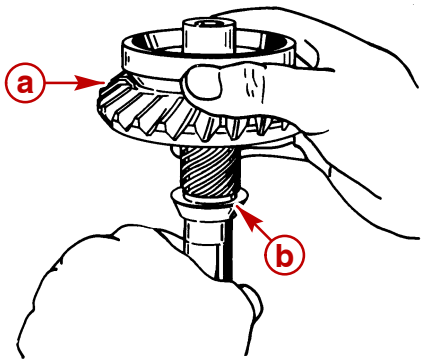
6. Remove bottom gear.

Inspection

1. Clean all parts in nontoxic solvent; then dry with compressed air. Be careful not to spin bearings. Inspect gears for pitting, chipped or broken teeth, and excessive or uneven wear. Replace gear if any of these conditions exist.
2. Condition of bearing surfaces in drive shaft housing and top cover are an indication of the condition of the bearings in the gears. Inspect bearing surface for pitting, grooves, scoring, discoloration from overheating, uneven wear, and embedded foreign metal particles. Replace gear and bearing assembly, and also bearing sleeve, if any of these conditions exist.
3. Inspect socket of gear for particles adhering to clutch surface, and for discoloration. If particles and/or discoloration are present, attempt to clean up grooves on clutch using a bead blaster or a pick. (Do not use a wire brush or wire wheel.) If, after cleaning, grooves appear to be flattened or nicked, clutch should then be replaced.
4. Inspect splines of clutch shaft for knicks or broken teeth. If any of these conditions exist, replace shaft.
5. Inspect bearing surfaces on clutch shaft for pitting, grooves, scoring, or discoloration. Replace shaft if any of these conditions exist.

Reassembly

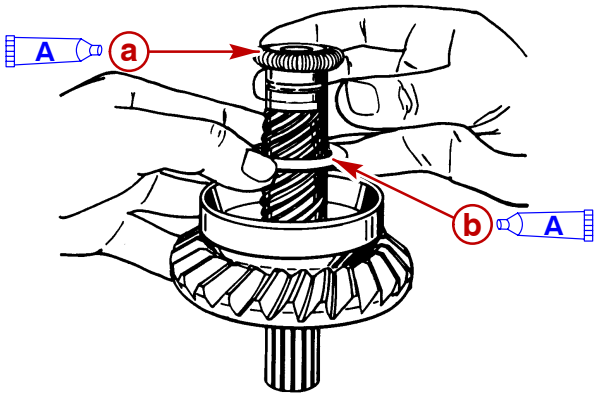
1. Apply lubricant to splines and install bottom gear on shaft and allow it to rest on thrust collar.



22106

a - Bottom gear
b - Thrust collar

2. Install thrust bearing and garter spring with silver side of bearing toward garter spring. Lubricate parts.

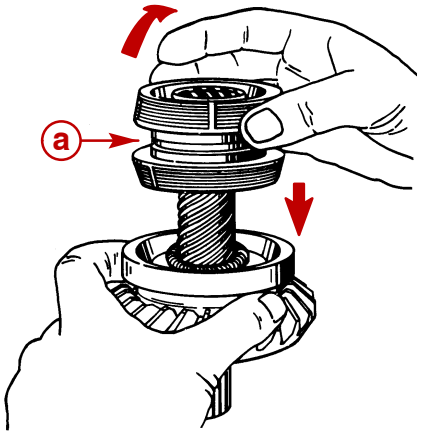


76848

a - Thrust bearing (silver side toward garter spring)
b - Garter spring

Description		Where Used	Part Number
A	High Performance Gear Lube	Thrust bearing	92-802854A1
		Garter spring	
		Splines	

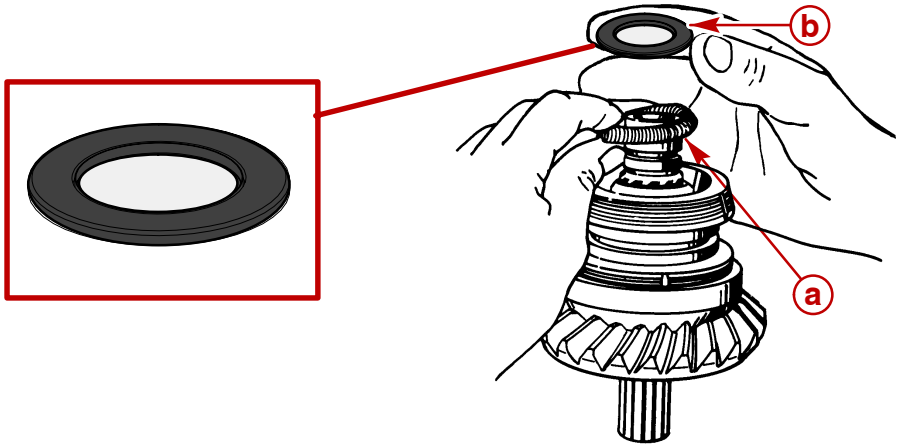
3. Lower clutch over shaft while allowing it to turn CLOCKWISE.



22106

a - Clutch

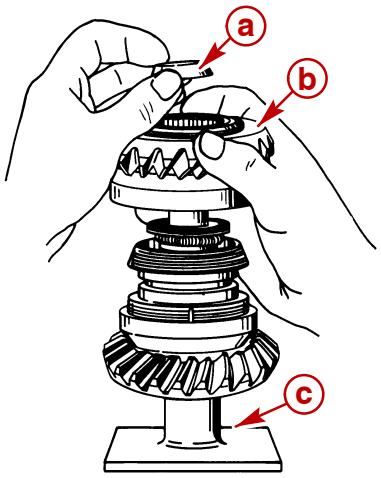
4. Install top garter spring and thrust bearing with silver side of bearing toward garter spring.



76862

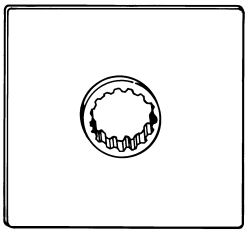
a - Garter spring (silver side toward garter spring)
b - Thrust bearing

5. Place top gear and then thrust collar over shaft.

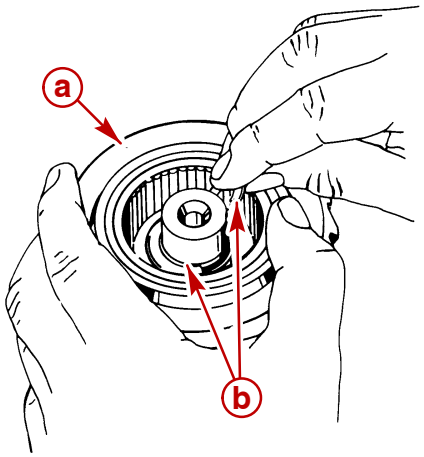


76847

a - Thrust collar
b - Top gear
c - Clutch Assembly Stand

Clutch Assembly Stand		
 73434	Holds the Bravo and Blackhawk clutch assemblies for servicing.	91-17301T1

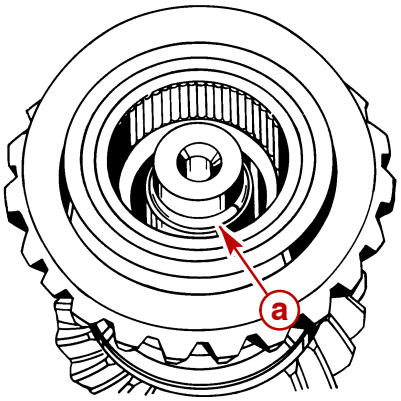
6. Press gear and thrust collar down so that groove in shaft is completely exposed. Install keepers.



22105

a - Top gear
b - Keepers (2)

7. Release pressure from gear. Thrust collar should come up to the point where top of keepers are level with top of thrust collar at position shown.



22105

a - Keepers level with thrust collar

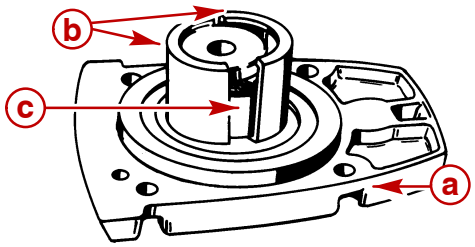
Drive Shaft Housing and Top Cover - Bearings and Bearing Sleeves

Inspection

1. Inspect needle bearing races in top cover and in drive shaft housing for pitting, grooves, discoloration, or embedded particles. If any of these conditions exist, replace race.
2. Condition of the bearing surfaces on the clutch shaft are an indication of the condition of the bearings in the top cover and drive shaft housing. Inspect bearing surface for pitting, grooves, discoloration, or embedded particles. If any of these conditions exist, then replace bearings and shaft.

Bearing Sleeve Removal (Top Cover)

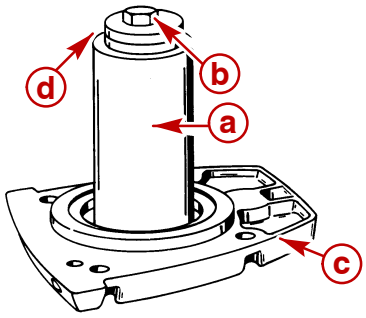
1. Place Puller Jaws around sleeve.



22083

a - Top cover
b - Puller Jaws (2 halves)
c - Bearing

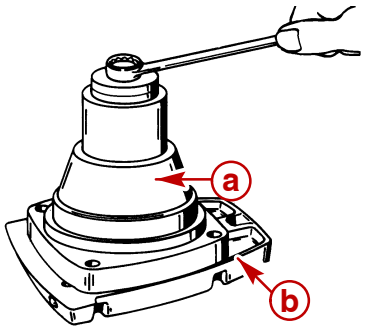
2. Position Puller Guide over jaws and install bolt.



22084

a - Puller Guide
b - Puller Bolt
c - Top cover
d - Washers

3. Install Driver Guide.



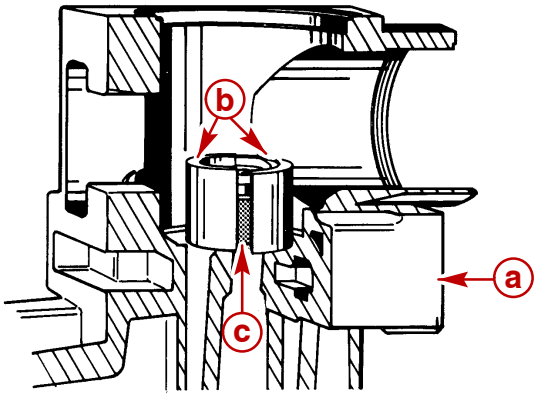
22082

a - Driver Guide
b - Top cover

4. Remove sleeve by rotating bolt CLOCKWISE.

Bearing Sleeve Removal (Drive Shaft Housing)

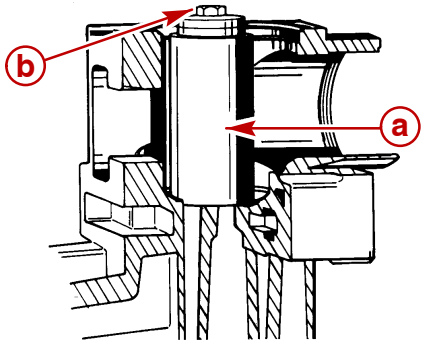
1. Place Puller Jaws around sleeve.



22219

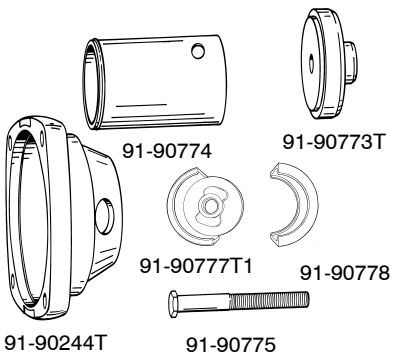
a - Drive shaft housing
b - Puller Jaws (2 halves)
c - Sleeve

2. Position Puller Guide over jaws and install bolt.

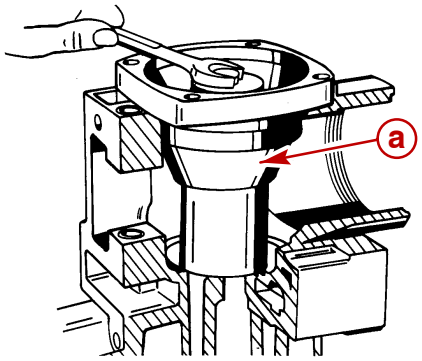


22263

a - Puller Guide
b - Puller Bolt

Puller / Driver Assembly		
	Installs and removes the drive shaft housing bearings and sleeves on all the Bravo and Blackhawk sterndrive units. Assembly includes the following and can be purchased separately: 91-90777T1 Puller Jaw 91-90778 Puller Jaw 91-90774 Puller Guide 91-90775 Puller Bolt 91-90244T Driver Guide 91-90773T Driver Head	91-90244A1

3. Install Driver Guide.



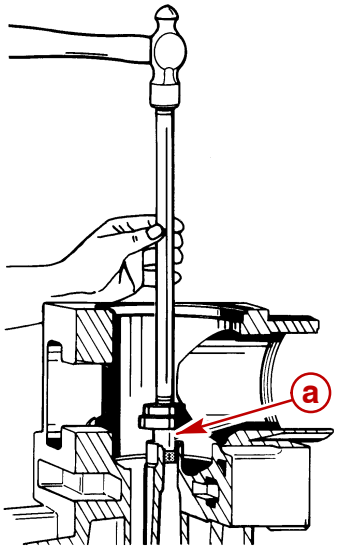
22258

a - Driver Guide

4. Remove sleeve by rotating bolt CLOCKWISE.

Roller Bearing Removal

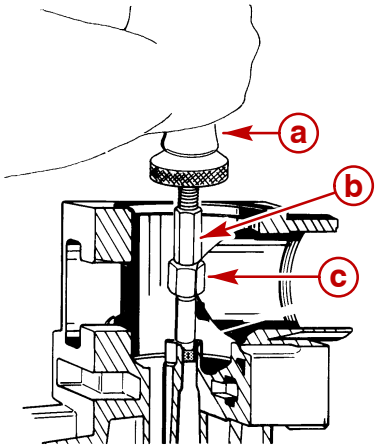
1. **Standard Bravo:** To remove roller bearing from drive shaft housing, use a suitable mandrel and drive bearing down into oil cavity.



22260

a - Bearing and mandrel

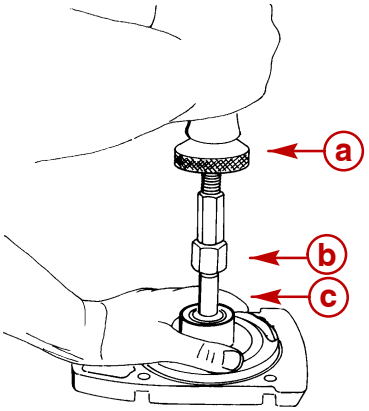
2. **Bravo X, XZ, XR and Diesel Bravo:** Remove roller bearing using a Slide Hammer Puller, Snap-On Adapter, and Puller Head.



76863

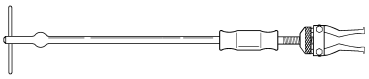
a - Slide Hammer Puller
b - Snap-On Adapter
c - Puller Head

3. Remove top cover roller bearing using a Slide Hammer Puller, Snap-On Adapter, and Puller Head.



73928

a - Slide Hammer Puller
b - Snap-On Adapter
c - Puller Head

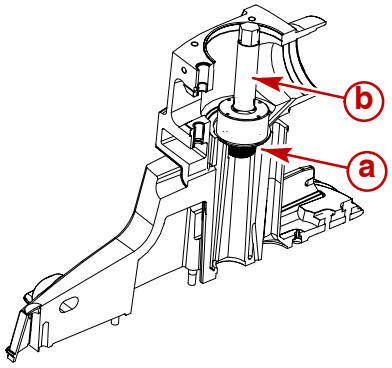
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

Description	**Part Number**
Snap-On Adapter	GC-40-4
Puller Head	GC-40-A10

Steel Bearing Adaptor Removal

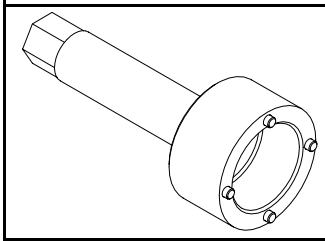
IMPORTANT: It is not necessary to remove the steel bearing adaptor for normal drive shaft housing disassembly. However, in the event of gear or bearing failure the steel bearing adaptor can be removed to aid in removal of metal chips and contamination from oil passages.

1. **Bravo X, XZ, XR, and Diesel Bravo:** Remove steel bearing adaptor using Steel Bearing Adapter Socket. Heat area around steel bearing adapter with a torch lamp to ease removal.

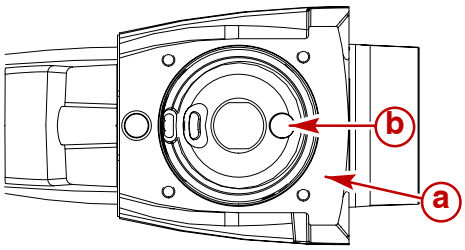


77021

a - Steel bearing adapter
b - Steel Bearing Adapter Socket

Steel Bearing Adapter Socket		
 78067	Installs and removes the steel bearing adapter on the Bravo X Series sterndrive units.	91-862531

2. Remove oil passage plug.



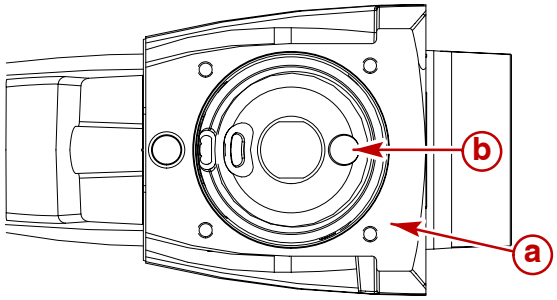
77043

a - Drive shaft housing
b - Oil passage plug

3. Clean metal chips and contamination from oil passage.

Steel Bearing Adapter Installation

1. **Bravo X, XZ, XR, and Diesel Bravo:** Install oil passage plug.



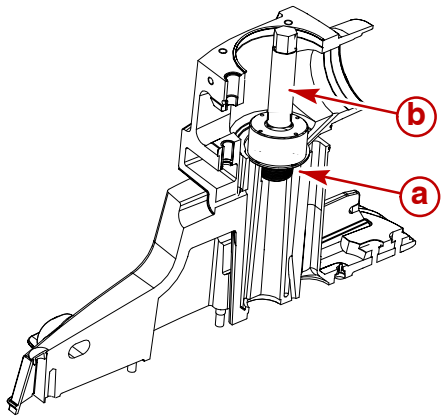
77043

a - Drive shaft housing
b - Oil passage plug

2. Clean threads of steel bearing adapter and apply lubricant.

Description	Where Used	Part Number
Loctite 277	Threads of steel bearing adapter	Obtain Locally

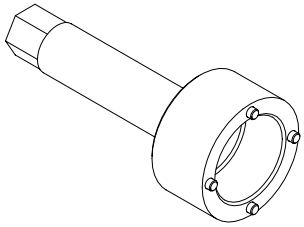
3. Install steel bearing adapter in drive shaft housing using Steel Bearing Adapter Socket.



77021

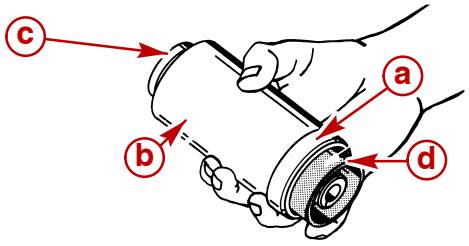
a - Steel bearing adapter
b - Steel Bearing Adapter Socket

Description	Nm	lb-in.	lb-ft
Steel bearing adapter	237		175

Steel Bearing Adapter Socket		
 78067	Installs and removes the steel bearing adapter on the Bravo X Series sterndrive units.	91-862531

Bearing Sleeve Installation

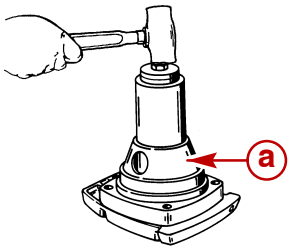
1. Install Driver Head onto Puller Guide. Secure Driver Head to Puller Guide with screw. Place bearing sleeve against edge of Driver Head.



22084

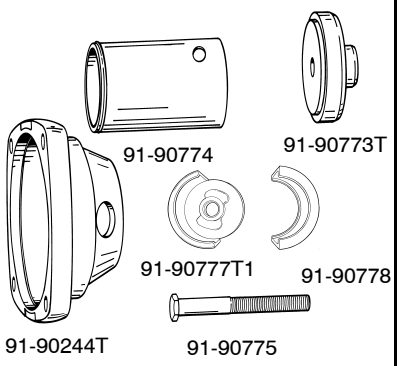
a - Driver Head
b - Puller Guide
c - Puller Bolt
d - Bearing sleeve

2. Place Driver Guide onto top cover.
3. Install Puller Guide Assembly through Driver Guide Assembly and install bearing sleeve by tapping into place until tool contacts the bottom surface.

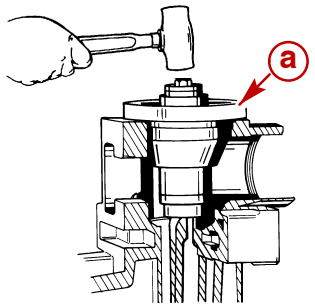


22082

a - Driver Guide

Puller / Driver Assembly		
	Installs and removes the drive shaft housing bearings and sleeves on all the Bravo and Blackhawk sterndrive units. Assembly includes the following and can be purchased separately: 91-90777T1 Puller Jaw 91-90778 Puller Jaw 91-90774 Puller Guide 91-90775 Puller Bolt 91-90244T Driver Guide 91-90773T Driver Head	91-90244A1

4. Place Driver Guide into top of drive shaft housing.
5. Install puller guide assembly through driver guide and install bearing sleeve by tapping into place until tool contacts.

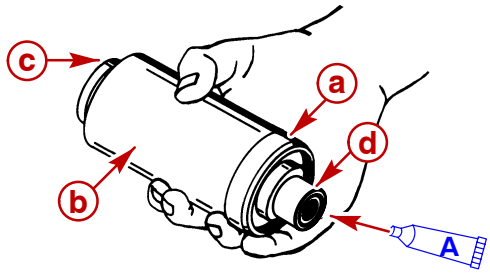


22263

a - Driver Guide

Roller Bearing Installation

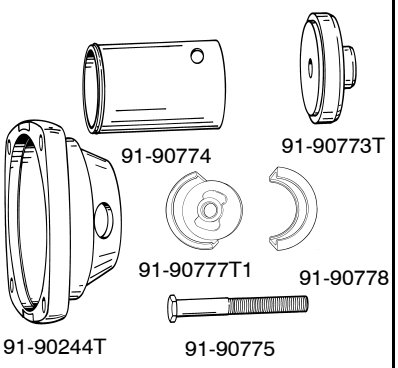
1. Install Driver Head onto Puller Guide.
2. Secure Driver Head to Puller Guide with screw.
3. Lubricate inside diameter of roller bearing and place roller bearing on Driver Head.



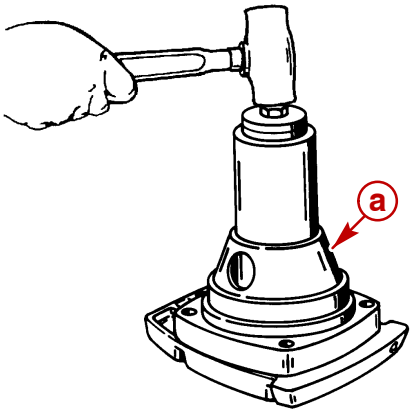
75967

a - Driver Head
b - Puller Guide
c - Puller Bolt
d - Roller bearing

Description		Where Used	Part Number
A	High Performance Gear Lube	Inside diameter of roller bearing	92-802854A1

Puller / Driver Assembly		
	Installs and removes the drive shaft housing bearings and sleeves on all the Bravo and Blackhawk sterndrive units. Assembly includes the following and can be purchased separately: 91-90777T1 Puller Jaw 91-90778 Puller Jaw 91-90774 Puller Guide 91-90775 Puller Bolt 91-90244T Driver Guide 91-90773T Driver Head	91-90244A1

4. Place Driver Guide on top cover.
5. Install Puller Guide Assembly through Driver Guide and install roller bearing by tapping into place until tool contacts.

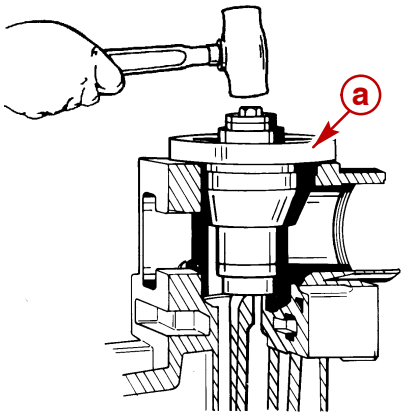


75968

a - Driver Guide

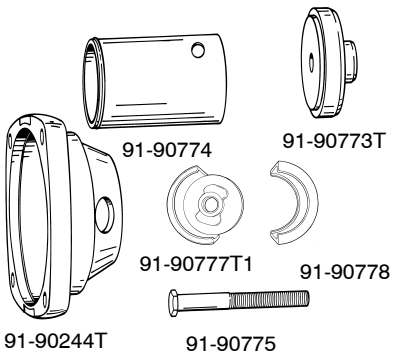
6. Place Driver Guide into top of drive shaft housing.

7. Install Puller Guide Assembly through Driver Guide and install roller bearing by tapping into place until tool contacts.



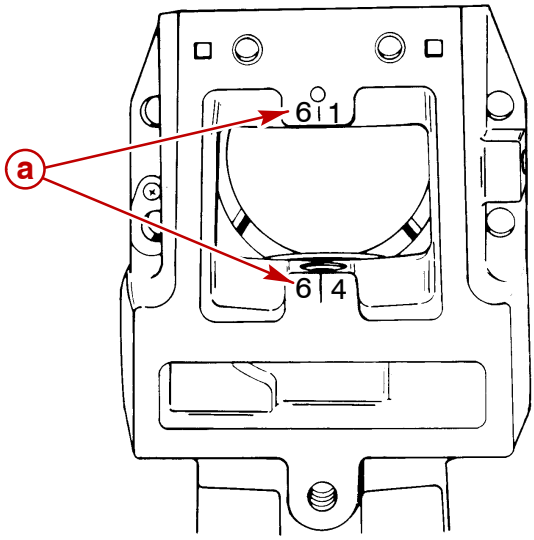
22263

a - Driver Guide

Puller / Driver Assembly		
	Installs and removes the drive shaft housing bearings and sleeves on all the Bravo and Blackhawk sterndrive units. Assembly includes the following and can be purchased separately: 91-90777T1 Puller Jaw 91-90778 Puller Jaw 91-90774 Puller Guide 91-90775 Puller Bolt 91-90244T Driver Guide 91-90773T Driver Head	91-90244A1

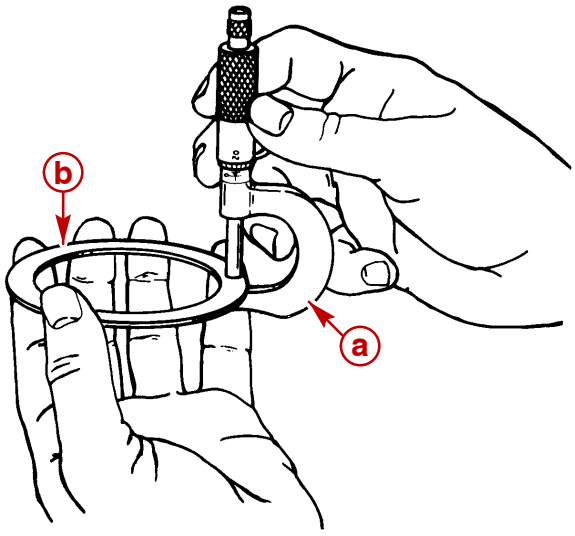
Drive Shaft Housing Reassembly

Two (2) numbers are stamped in the shifter cavity on the back of the drive shaft housing. The top number designates the thickness of the top thrust bearing race, and the bottom number designates the thickness of the bottom thrust bearing race. Use numbers that are stamped in housing as a guide for obtaining replacement parts. Measure thrust bearing races with a micrometer to ensure that their thickness correspond to the numbers stamped in the drive shaft housing.



76849

a - Stamped number

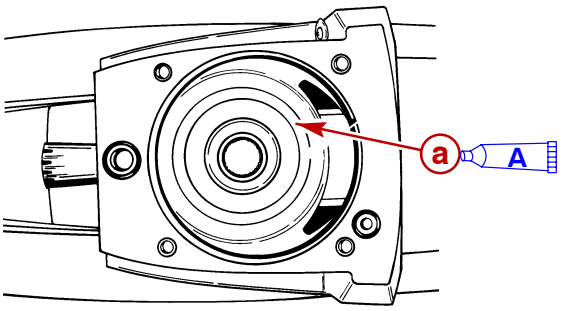


22100

a - Micrometer
b - Race

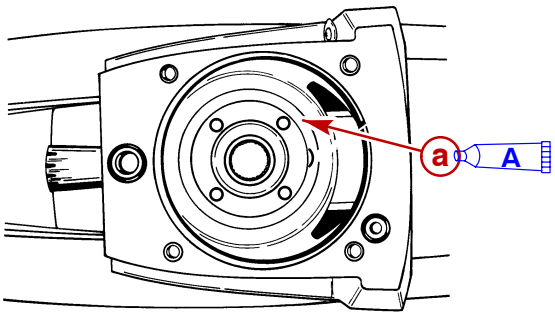
NOTE: *If using original thrust bearing race, race should be installed so that the side of original contact area is in the same position as removed. Prelube all races and bearings with High-Performance Lube.*

1. Position correct thrust bearing race in drive shaft housing.



22437

Standard Bravo



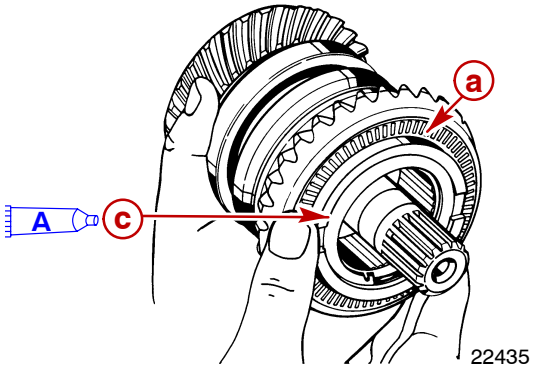
76850

Bravo X, XZ, XR, and Diesel Bravo

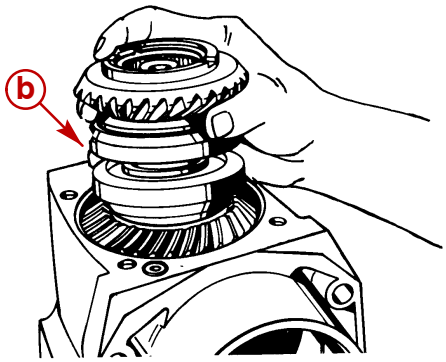
a - Thrust bearing race

Description		Where Used	Part Number
A	High-Performance Gear Lube	Thrust bearing race	92-802854A1

2. Apply a mixture of 60% Hi Performance Gear Lube and 40% Special Lubricant 101 to bottom face of bottom gear.
3. Stick thrust bearing to gear.
4. Install clutch assembly.



22435

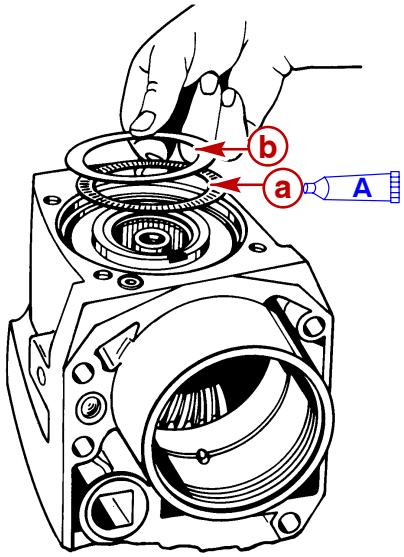


22099

a - Thrust bearing
b - Gear assembly
c - Bottom face of gear

Description		Where Used	Part Number
A	60% High-Performance Gear Lube	Bottom face of bottom gear	92-802854A1
	40% Special Lubricant 101		92-802865A1

5. Apply a mixture of 60% Hi Performance Gear Lube and 40% Special Lubricant 101 to the top face top gear and the thrust bearing.
6. Place thrust bearing on gear.
7. Position correct thrust bearing race on top of thrust bearing.



50304

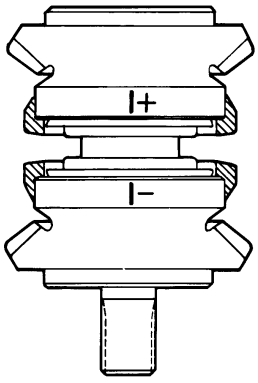
a - Thrust bearing
b - Thrust race

Description		Where Used	Part Number
A	60% High-Performance Gear Lube	Top face of gear and thrust bearing	92-802854A1
	40% Special Lubricant 101		92-802865A1

⚠ CAUTION

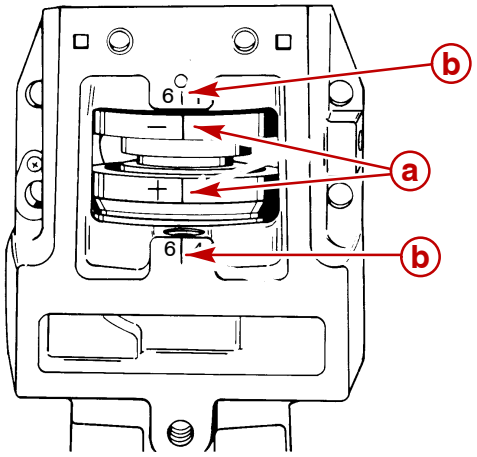
Gear assembly must be timed as shown, following, or damage to gears and U-joint pinion gear may occur.

- Timing marks on gears must be aligned in one of two ways. The positive (+) mark over the negative (–) or the negative (–) mark over the positive (+) mark. NEVER align two positive (+) marks or two negative (–) marks.



22107

8. Align clutch gear timing marks with index marks on drive shaft housing as close as possible.



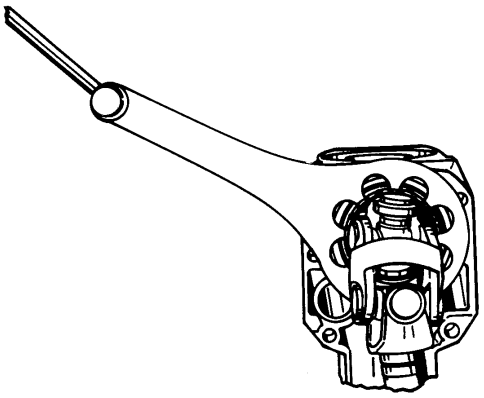
76805

a - Timing marks
b - Index marks

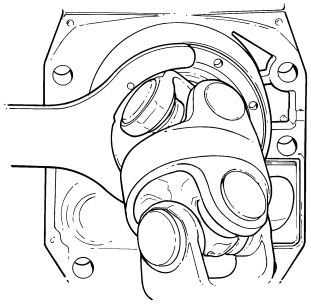
IMPORTANT: *Ensure that the retainer nut is not cross-threaded by turning the retainer nut COUNTERCLOCKWISE until thread engagement is felt; then turn retainer nut clockwise.*

9. Install U-joint assembly into drive shaft housing. Apply lubricant to threads of retainer nut and install. Torque retainer nut.

NOTE: *On Bravo X, XZ, XR, and Diesel Bravo, the retainer nut must be started using retainer nut spanner wrench.*



22094



77078

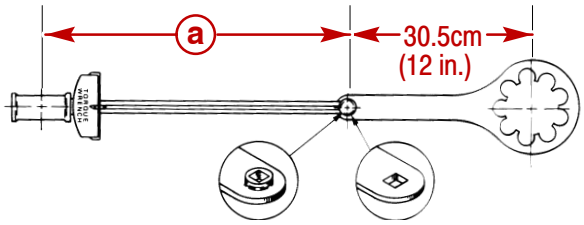
Standard Bravo **Bravo X, XZ, XR, and Diesel Bravo**

Description	Where Used	Part Number
Special Lubricant 101	Threads of retainer nut	92-802865A1

Description	Nm	lb-in.	lb-ft
U-joint retainer nut	271		200

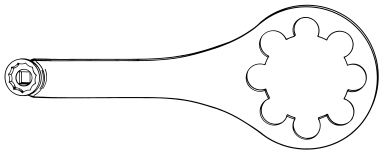
Torque Conversion Chart For U-joint Retainer Nut Tool

Torque Wrench Length		Torque Wrench Reading in (Nm) lb-ft to Achieve 271 Nm (200 lb-ft)	
mm	in.	Nm	lb–ft
381	15	151	111
406	16	155	114
432	17	159	117
457	18	163	120
483	19	167	123
508	20	170	125
533	21	172	127
559	22	175	129
584	23	178	131
610	24	180	133
635	25	183	135
660	26	184	136
686	27	187	138
711	28	190	140
737	29	191	141
762	30	194	143
787	31	195	144
813	32	197	145
838	33	200	147
864	34	201	148
889	35	202	149
914	36	203	150



Typical Bravo retainer nut tool shown

a - Torque wrench length

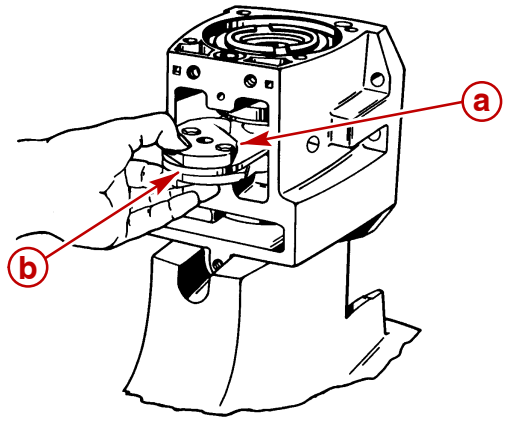
Bearing Retainer Wrench		
 73482	Installs and removes the drive shaft bearing retainer on the Blackhawk and all Mercury MerCruiser Bravo sterndrive units, excluding the Bravo X series.	91-17256

Torquing Bravo U-joint Bearing Retainer Nut

Use the following procedure to allow torquing retainer nut with a torque wrench.

- On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.
- On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (2 bands, etc.).

1. Ensure that timing marks are still properly aligned (by turning U-joint, if necessary). If marks have moved; remove U-joint assembly and start over beginning with step 5 of the Drive Shaft Housing Reassembly.
2. Install shift cam assembly into shifter cavity in drive shaft housing with the shift cam nuts facing the bottom of the drive shaft housing.

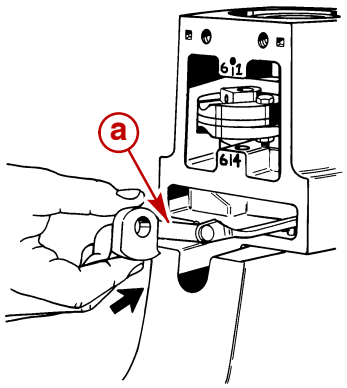


76838

Shift cam assembly

a - Shift cam assembly
b - Boss

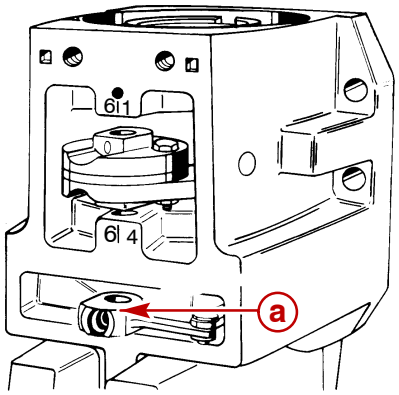
3. Push linkage assembly into place. If linkage binds, move assembly gently from side to side while pushing.



76853

a - Linkage assembly

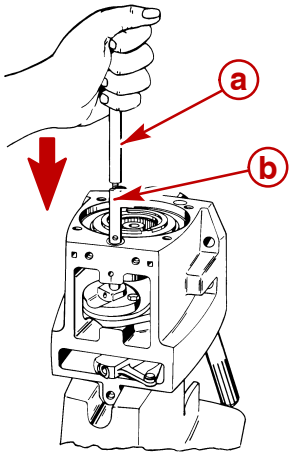
4. Turn linkage assembly 1/4 turn COUNTERCLOCKWISE and position as shown.



76852

a - Linkage assembly

5. Install Shift Handle Tool in shifter shaft and push shaft down. Remove tool.

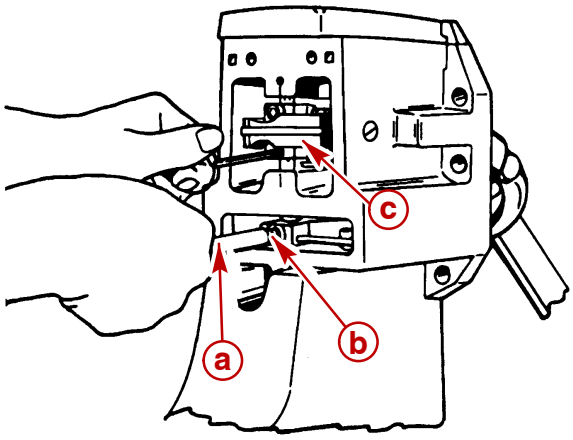


50306

a - Shift Handle Tool
b - Shifter shaft

Shift Handle Tool		
73357	Positions and removes the shifter shaft on the Bravo One and Bravo Two sterndrive units.	91-17302

6. Install shift handle tool through shift linkage and into shifter shaft. Move shifter shaft back and forth as necessary to align lower hole in shift cam assembly with threaded hole in shifter shaft.
7. Apply sealant to the first 2 or 3 threads of screw.
8. Install shift cam cap screw and torque.



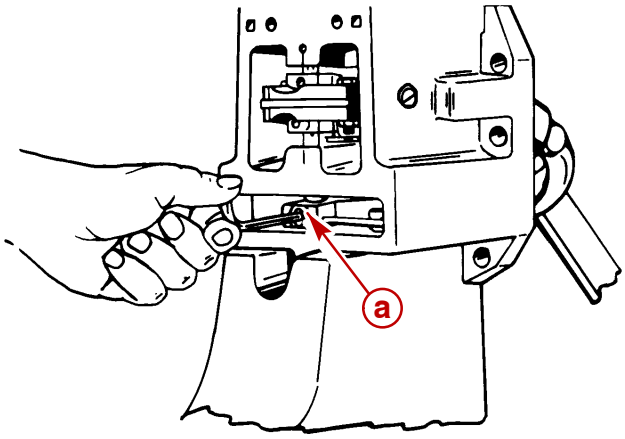
76864

a - Shift Handle Tool
b - Shift linkage
c - Shift cam assembly

Description	Where Used	Part Number
Loctite 271 Threadlocker	First 2 or 3 threads of shift cam cap screw	92-809819

Description	Nm	lb-in.	lb-ft
Shift cam cap screw	12-13	100 -120	

9. Apply sealant to first 2-3 threads of shift linkage cap screw and install. Torque cap screw.



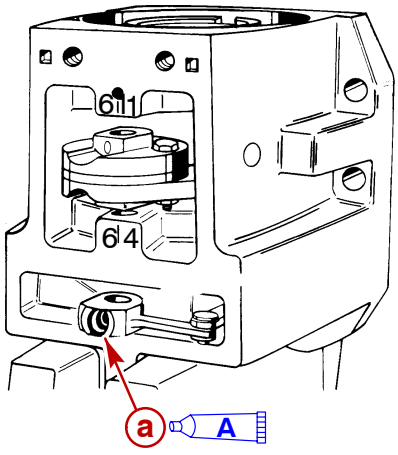
76854

a - Cap screw

Description	Where Used	Part Number
Loctite 271 Threadlocker	Shift linkage cap screw	92-809819

Description	Nm	lb-in.	lb-ft
Shift linkage cap screw	12-13	100 -120	

10. Move shift linkage to the neutral detent position. Apply liberal amount of lubricant to inner diameter of screw recess.

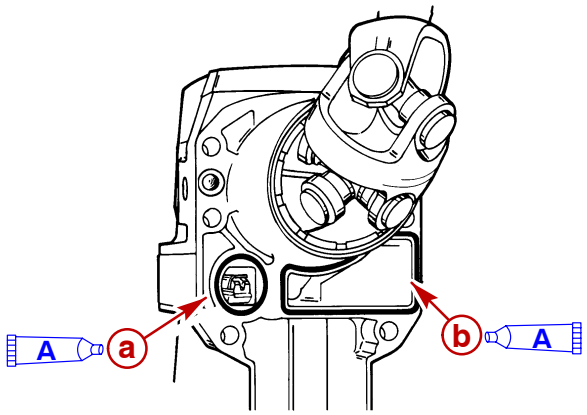


76852

a - Screw recess

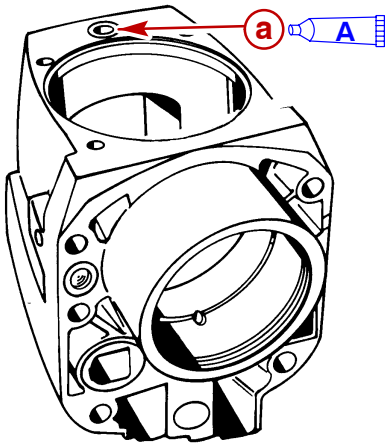
Description		Where Used	Part Number
A	Special Lubricant 101	Inner diameter of screw recess	92-802865A1

11. Replace O-rings in drive shaft housing. Apply adhesive to O-rings before installation.

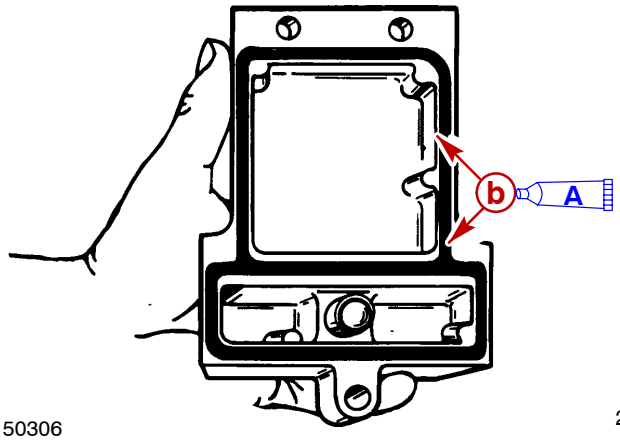


50356

a - Shift linkage O-ring
b - Water passage O-ring

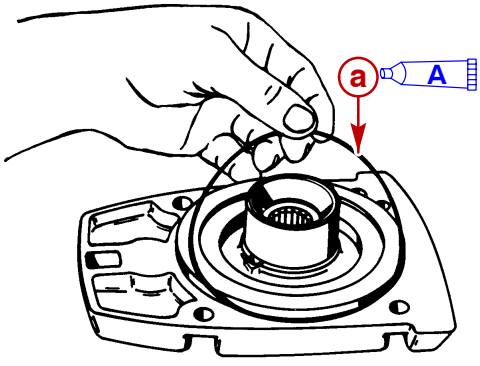


50306



22100

a - Shifter shaft O-ring
b - Back cover O-ring

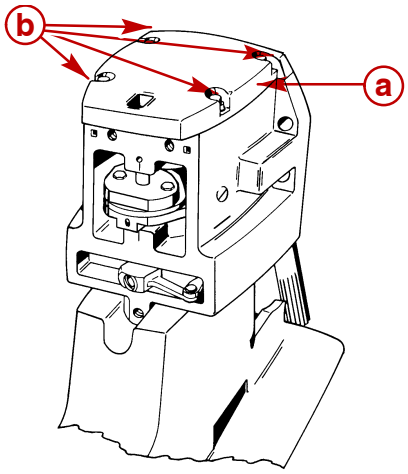


22088

a - Top cover O-ring

Description		Where Used	Part Number
A	Bellows Adhesive	O-rings	92-86166Q1

12. Install top cover.
13. Torque screws.



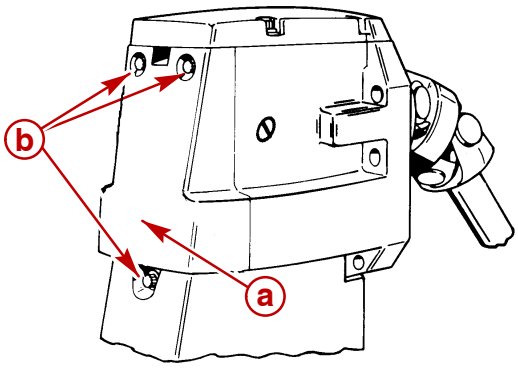
76835

a - Top cover
b - Screws

Description	Nm	lb-in.	lb-ft
Drive shaft housing top cover screws	27		20

14. Install rear cover and screws.
15. Torque screws.

NOTE: *To avoid damage to cover, evenly tighten screws until cover is flush against drive shaft housing before torquing screws.*



76805

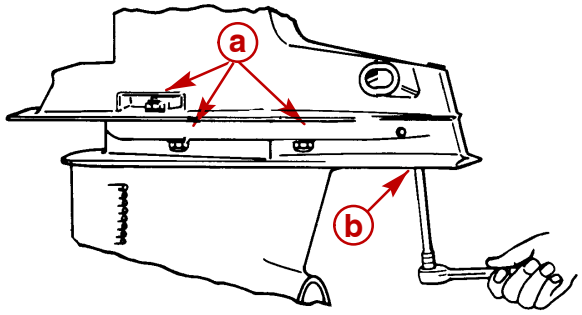
a - Rear cover
b - Screws (3)

Description	Nm	lb-in.	lb-ft
Drive shaft housing rear cover screws	27		20

Drive Shaft Housing To Gear Case Installation

1. **Bravo One, Bravo XZ, Bravo XR, and Diesel Bravo One X:**

   a. Install gear housing to drive shaft housing. Torque nuts and bolt.



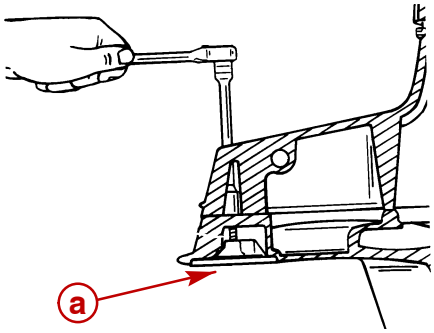
76801

a - Nuts and washers (6)
b - Bolt (located in trim tab cavity) (1)

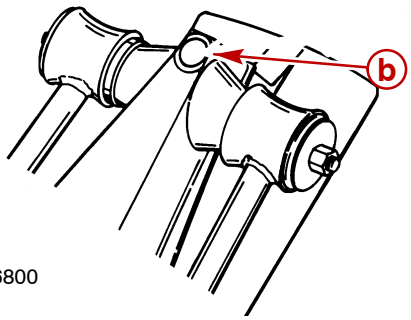
Description	Nm	lb-in.	lb-ft
Gear housing to drive shaft housing nuts and bolts	47		35

   b. Install anodic plate and torque.

   c. Install rubber plug.



76800



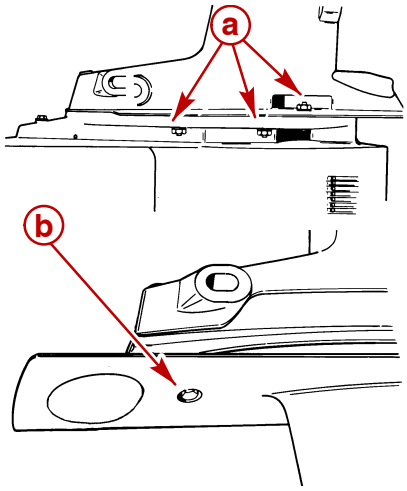
22093

a - Anodic plate
b - Rubber plug

Description	Nm	lb-in.	lb-ft
Anodic plate	27		20

2. **Bravo Two and Diesel Bravo Two X:**

a. Install gear housing to drive shaft housing. Torque nuts and bolt.

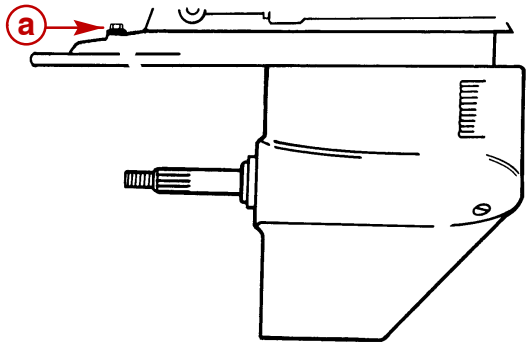


76802

a - Nuts and washers (6)
b - Bolt (located in front of trim tab) (1)

Description	Nm	lb-in.	lb-ft
Gear housing to drive shaft housing, nuts, and bolts	47		35

b. Install anodic plate and torque bolt.



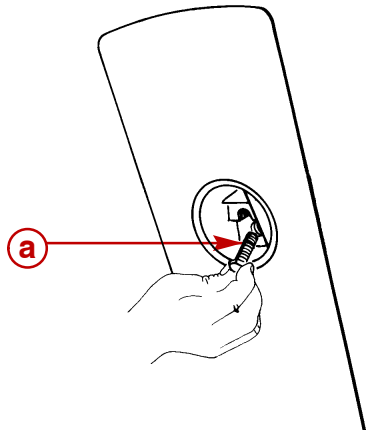
76801

a - 1/2 in. bolt

Description	Nm	lb-in.	lb-ft
Anodic plate bolt	27		20

3. **Bravo Three and Diesel Bravo Three X:**

a. Install the bolt in the anode cavity. Torque bolt.

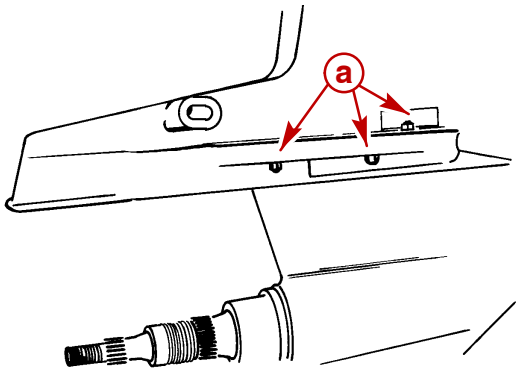


76804

a - Bolt

Description	Nm	lb-in.	lb-ft
Anode cavity bolt	47		35

b. Install the remaining fasteners and torque.



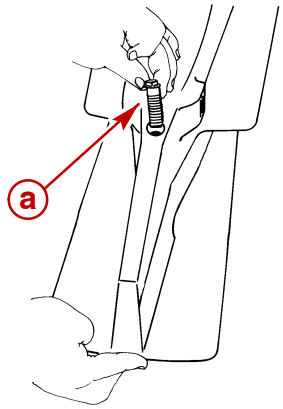
76803

a - 6 nuts and washers

Description	Nm	lb-in.	lb-ft
Fastener nuts	47		35

c. Install anode.

d. Torque bolt. Install rubber plug.



76832

a - Anode bolt

Description	Nm	lb-in.	lb-ft
Anode bolt	27		20

4. Fill sterndrive unit. (Refer to **Section 1B**)

NOTES:

STERNDRIVE UNIT

Section 3B - Bravo One Gear Housing

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3 B

Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

Description	Nm	lb-in.	lb-ft
Drive shaft pinion screw	61		45
Clamp plate	47		35
Rolling preload of drive shaft	0.3-0.6	3-5	
Gear housing to drive shaft housing nuts and bolts	47		35
Anodic plate bolt	27		20
Propeller locknut	75		55

Specifications

Gear Backlash

Description	mm	in.
Gear backlash	0.30-0.38	0.012-0.015

Pinion Gear Clearance

Description	mm	in.
Pinion gear clearance	0.635	0.025

Bearing Preloads

Description	Nm	lb-in
Drive shaft bearings	0.3-0.5	3-5
Propeller shaft bearings Checked at propeller shaft (new bearings)	0.9-1.4[1]	8-12[1]
Propeller shaft bearings - Checked at propeller shaft (used bearings)[2]	0.6-0.9[1]	5-8[1]

[1] *Does not include 3-5 lb-in. (0.3-0.55 Nm) of preload on drive shaft bearings.*

[2] *A bearing is used if spun once under load.*

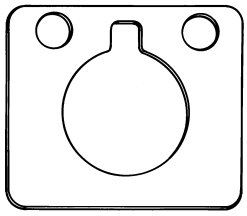
Gear Ratio - Teeth Per Gear (Gear Housing)

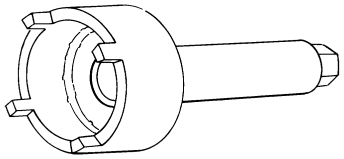
Ratio	Pinion	Driven
1.65:1	15	19
1.50:1	15	19
1.36:1	15	19

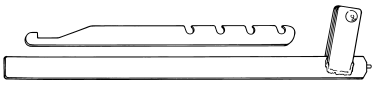
Lubricants / Sealants / Adhesives

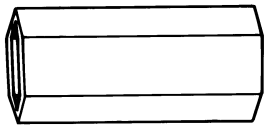
Description	Where Used	Part Number
High Performance Gear Lube	Tapered bearings	92-802854A1
	Bearing cup	
	Outside casting diameter	
	O-ring	
	Inner diameter of tapered roller bearing	
Bellows Adhesive	Seal water passage	92-86166Q1
2-4-C with Teflon	Coupler	92-802859A1
	Inner diameter of seal	
	Propeller shaft	
Perfect Seal	Anodic plate screw	92-34227-1
	Bearing carrier ends	
Loctite 271 Threadlocker	Screw	92-809819
	Outer diameter of seal	
Special Lubricant 101	Bearing carrier retainer	92-802865A1
	Propeller shaft	
Engine Coupler-Spline Grease	Propeller shaft splines	92-802869A1
Needle Bearing Assembly Lubricant	Needle bearings	90-802868A1
Anti-Corrosion Grease	Propeller shaft	92-802867A1

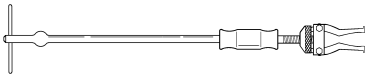
Special Tools

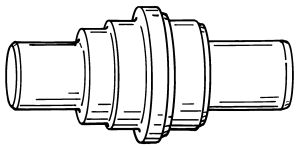
Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

Bearing Carrier Retainer Nut Wrench		
 73605	Installs and removes the bearing carrier retainer nuts on the Bravo One, Two and Three sterndrive units.	91-61069T

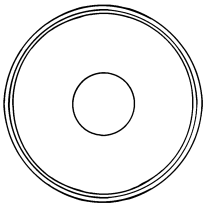
Puller Bar		
 73525	Removes the bearing carrier from all the Bravo One / Bravo Two and all Bravo XR and XZ sterndrive units.	91-90338A1

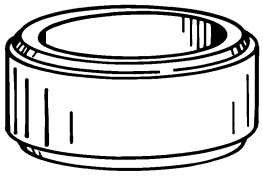
Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo and Blackhawk sterndrive units.	91-61077T

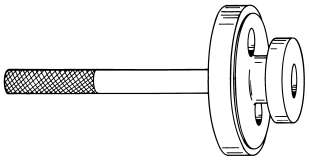
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

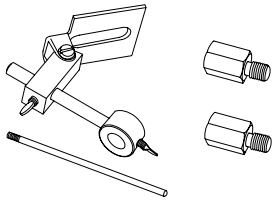
Bearing Carrier Seals and Bearing Cup Driver		
 73463	Installs the bearing carrier seals on the Bravo One and Bravo Two sterndrive units.	91-89865

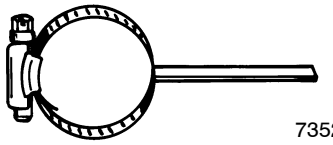
Special Tools (continued)

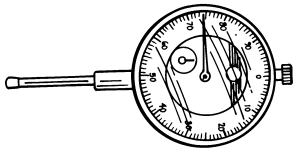
Bearing Cup Driver		
 74189	Installs the driven gear bearing cup on the Bravo One and Bravo Two sterndrive units.	91-31106T

Bearing Cup Driver		
 73460	Installs the drive shaft bearing cup in the gear housing and bearing cup in the bearing carrier of the Bravo One and Bravo Two sterndrive units.	91-67443T

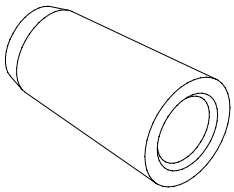
Drive Shaft Pinion Gear Shimming Tool		
 73454	Shims the pinion gear on the Bravo One sterndrive units.	91-42840T

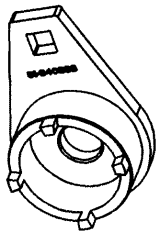
Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-83155

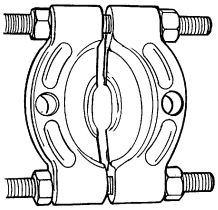
Backlash Indicator Rod		
 73520	Indicates the inner propeller shaft backlash on the Bravo Three and Blackhawk sterndrive units.	91-805481

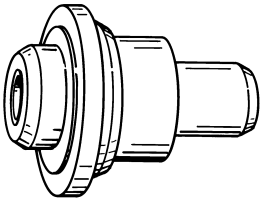
Dial Indicator		
 73429	Measures the gear backlash on all the Alpha and Bravo sterndrive units.	91-58222A1

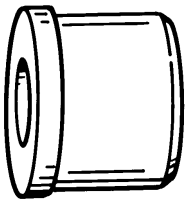
Special Tools (continued)

Bearing Carrier Installation Tool		
 78070	Installs the bearing carrier on the Bravo One with High Performance Propeller Shaft Kit installed on the lower unit, and the Bravo XZ and XR sterndrive units.	91-840388

Bearing Carrier Retainer Nut Wrench		
 78059	Installs the bearing carrier retainer nut on the Bravo One with High Performance Propeller Shaft Kit installed on the lower unit, and Bravo XZ and XR sterndrive units. Bearing Carrier Retainer Nut Wrench included with Propeller Shaft Tool Kit 91-840393A1.	91-840393

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

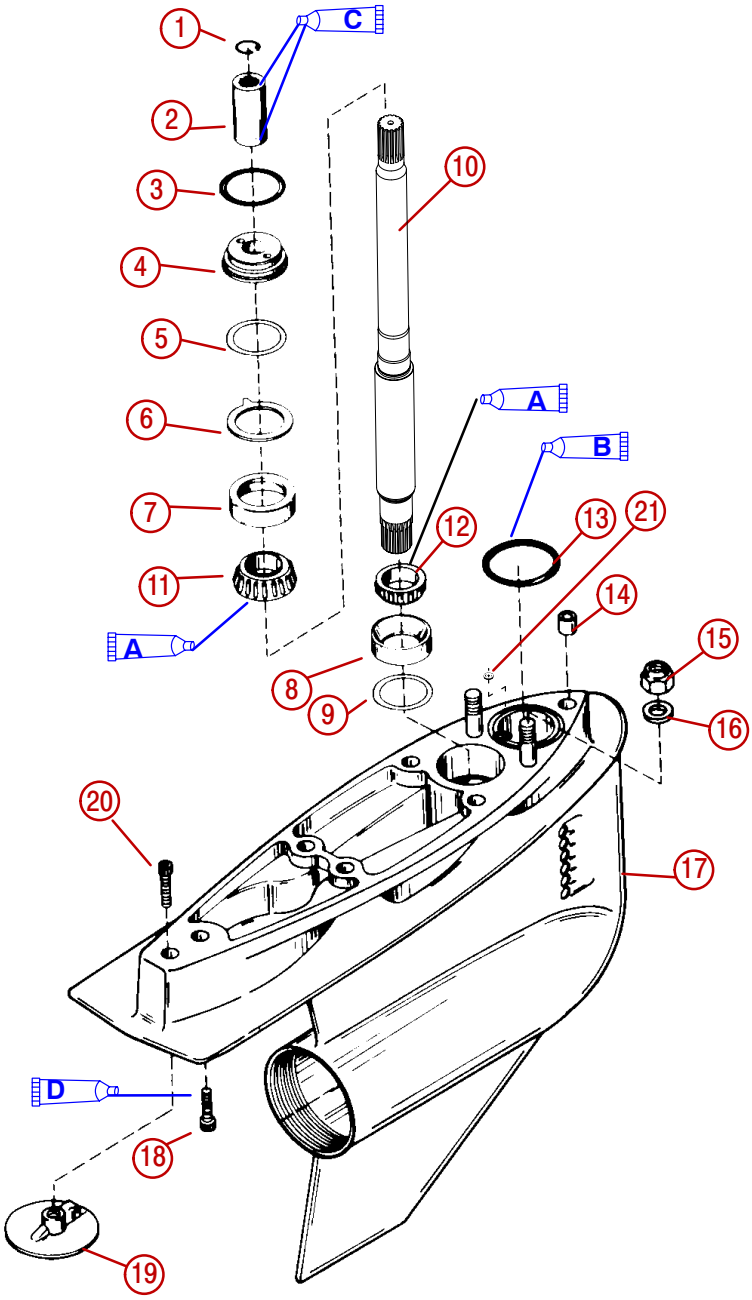
Bearing Driver		
 73447	Installs and removes the lower drive shaft pinion bearing on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-63638T

NOTE: *Puller Shaft (91-31229) and Driver Head Rod (91-37323) are included in Bearing Removal and Installation Tool Assembly (91-31229A7).*

NOTES:

Bravo One Gear Housing Exploded Views

Drive Shaft Components



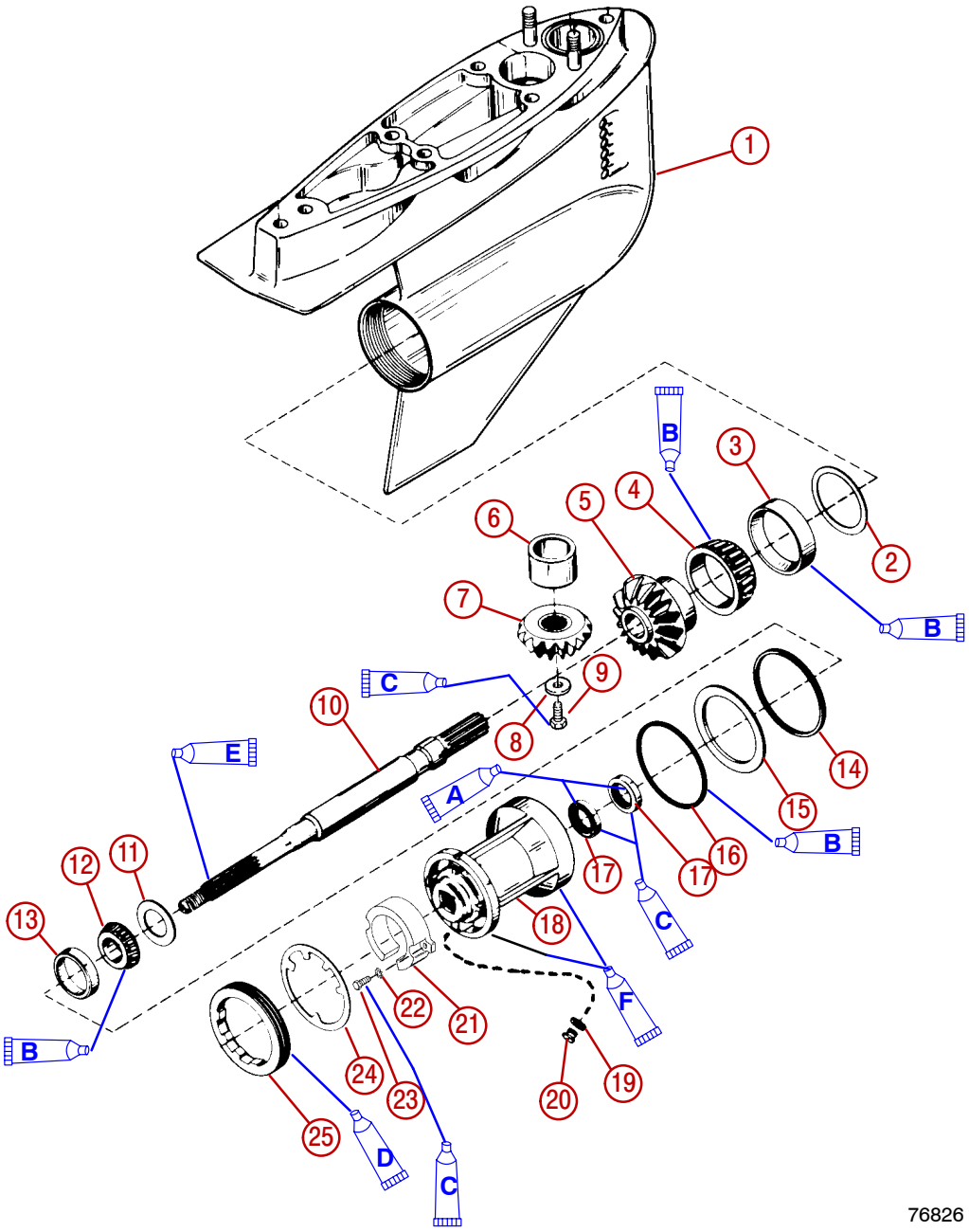
76865

Drive Shaft Components (continued)

1 - Retainer
2 - Coupler
3 - O-ring
4 - Spacer
5 - Shims
6 - Tab washer
7 - Bearing cup
8 - Bearing cup
9 - Shims
10 - Drive shaft
11 - Tapered bearing (larger diameter)
12 - Tapered bearing (smaller diameter)
13 - Water passage seal
14 - Speedometer water passage seal
15 - Locknut
16 - Flat washer
17 - Gear housing
18 - Anode cavity bolt
19 - Anodic plate
20 - Anode plate bolt
21 - Quad ring

Description		Where Used	Part Number
A	High Performance Gear Lube	Tapered bearings	92-802854A1
B	Bellows Adhesive	Seal water passage	92-86166Q1
C	2-4-C with Teflon	Coupler	92-802859A1
D	Perfect Seal	Anodic plate screw	92-34227-1

Bravo One and Diesel Bravo One X Propeller Shaft Components

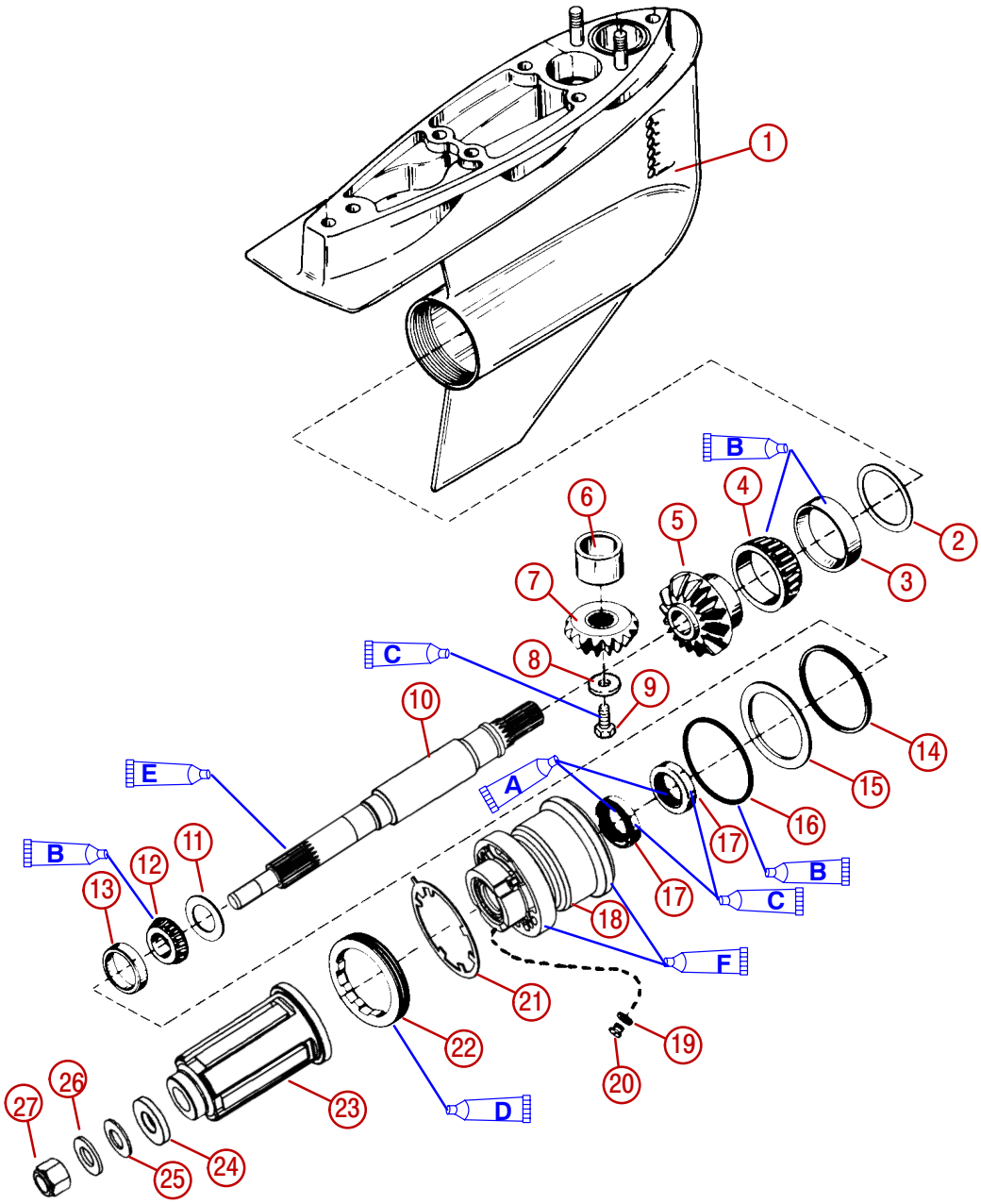


Bravo One and Diesel Bravo One X Propeller Shaft Components (continued)

1 - Gear housing
2 - Shims
3 - Bearing cup
4 - Tapered bearing
5 - Driven gear
6 - Needle bearing
7 - Pinion gear
8 - Washer
9 - Screw
10 - Propeller shaft
11 - Washer
12 - Tapered bearing
13 - Bearing cup
14 - Load ring
15 - Washer
16 - O-ring
17 - Seals
18 - Bearing carrier
19 - Washer
20 - Drain screw
21 - Propeller anode
22 - Lockwasher
23 - Screw
24 - Tab washer
25 - Bearing carrier retainer

Description		Where Used	Part Number
A	2-4-C with Teflon	Inner diameter of seal	92-802859A1
B	High Performance Gear Lube	Bearing cup	92-802854A1
		Tapered bearing	
		O-ring	
C	Loctite 271 Threadlocker	Screw	92-809819
		Outer diameter of seal	
D	Special Lubricant 101	Bearing carrier retainer	92-802865A1
		Propeller shaft	
E	Engine Coupler-Spline Grease	Propeller shaft splines	92-802869A1
F	Perfect Seal	Bearing carrier ends	92-34227-1
G	Anti-Corrosion Grease	Propeller shaft	92-802867A1

Bravo XZ and Bravo XR Propeller Shaft Components



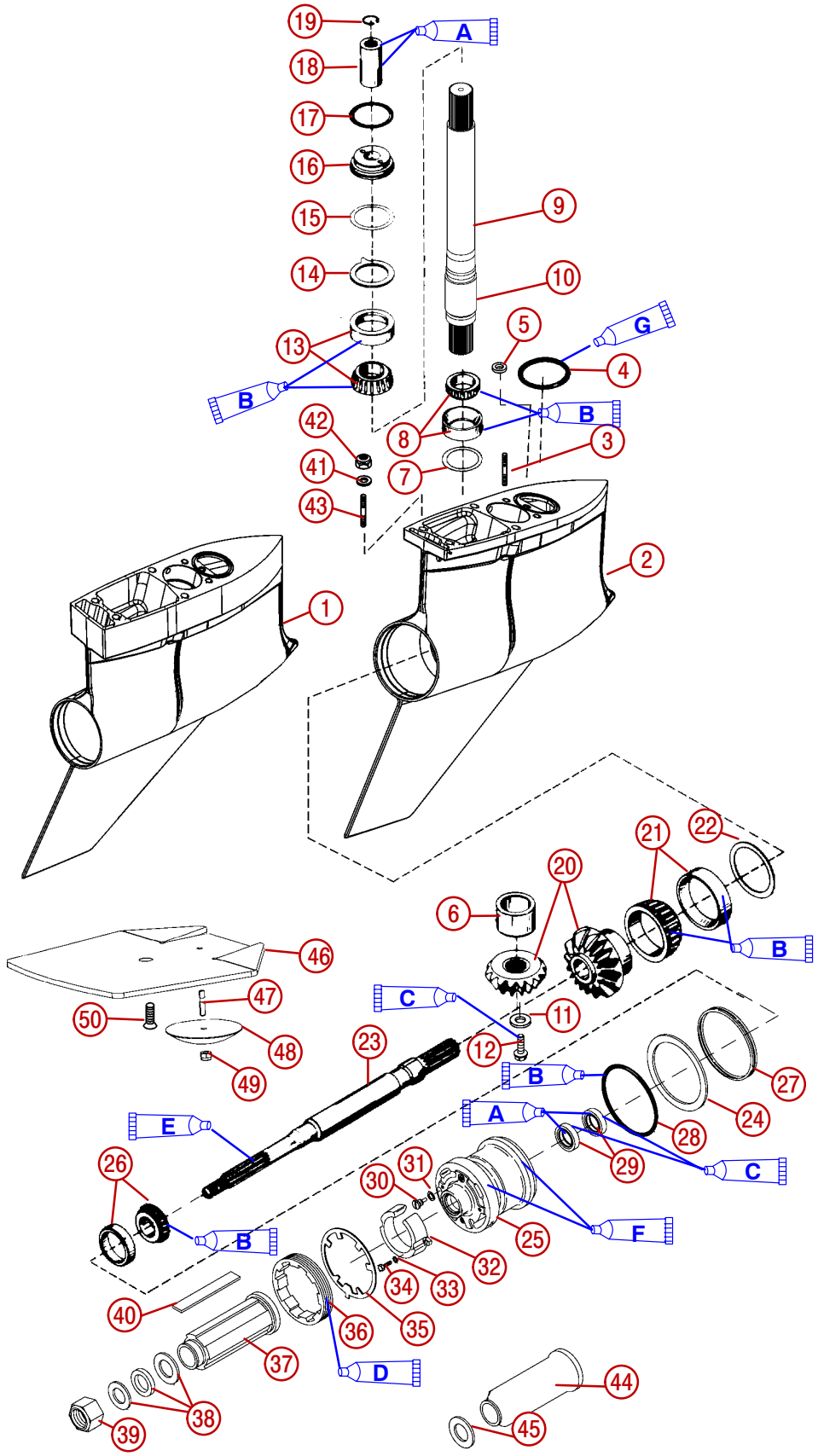
77109

Bravo XZ and Bravo XR Propeller Shaft Components (continued)

1 - Gear housing
2 - Shims
3 - Bearing cup
4 - Tapered bearing
5 - Driven gear
6 - Needle bearing
7 - Pinion gear
8 - Washer
9 - Screw
10 - Propeller shaft
11 - Washer
12 - Tapered bearing
13 - Bearing cup
14 - Load ring
15 - Washer
16 - O-ring
17 - Seals
18 - Bearing carrier
19 - Washer
20 - Drain screw
21 - Tab washer
22 - Bearing carrier retainer
23 - Propeller hub assembly
24 - Washer
25 - Belleville washer
26 - Washer
27 - Propeller nut

Description		Where Used	Part Number
A	2-4-C with Teflon	Inner diameter of seal	92-802859A1
B	High Performance Gear Lube	Bearing cup	92-802854A1
		O-ring	
		Tapered bearing	
C	Loctite 271 Threadlocker	Screw	92-809819
		Bearing carrier retainer	
D	Special Lubricant 101	Outer diameter of seal	92-802865A1
		Propeller shaft	
E	Engine Coupler-Spline Grease	Propeller shaft splines	92-802869A1
F	Perfect Seal	Bearing carrier ends	92-34227-1
G	Anti-Corrosion Grease	Propeller shaft	92-802867A1

Super SportMaster Gear Housing And Drive Shaft Components



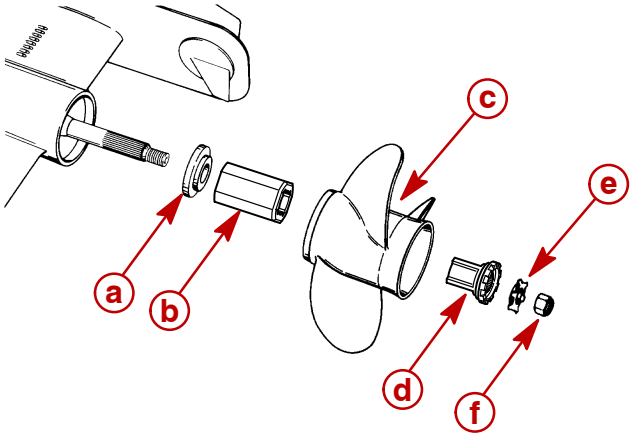
Super SportMaster Gear Housing And Drive Shaft Components (continued)

1 - Gear housing assembly (long style models)
2 - Gear housing assembly (short style models)
3 - Stud (2)
4 - O-ring, water passage seal
5 - Quad ring seal
6 - Needle bearing
7 - Shim set
8 - Tapered bearing assembly
9 - Drive shaft assembly (long style models) and drive shaft assembly (short style models)
10 - Race bearing
11 - Washer
12 - Screw
13 - Tapered bearing Assembly
14 - Tab washer
15 - Shim set spacer
16 - Spacer
17 - O-ring
18 - Coupling assembly
19 - Ring retaining
20 - Gear sets (15/19 teeth), (15/17 teeth), (17/18 teeth)
21 - Tapered bearing assembly
22 - Shim set
23 - Propeller shaft
24 - Thrust washer
25 - Bearing carrier assembly
26 - Tapered bearing kit
27 - Load ring
28 - O-ring
29 - Oil seal
30 - Oil drain screw
31 - Sealing washer
32 - Anode kit
33 - Lockwasher (#10)
34 - Screw
35 - Keyed washer
36 - Bearing carrier retainer
37 - Propeller hub
38 - Washer and nut kit
39 - Propeller nut
40 - Snubber
41 - Washer
42 - Nut
43 - Stud for long style and stud for short style models
44 - Propshaft cover
45 - Washer
46 - Splash plate assembly
47 - Stud
48 - Anode
49 - Nut
50 - Screw

Description		Where Used	Part Number
A	2-4-C with Teflon	Inner diameter of seal	92-802859A1
		Outer and inner diameter of coupler	
B	High Performance Gear Lube	Bearing cup	92-802854A1
		Tapered bearings	
		O-ring	
C	Loctite 271 Threadlocker	Screw	92-809819
		Outer diameter of seal	
D	Special Lubricant 101	Bearing carrier retainer	92-802865A1
		Propeller shaft	
E	Engine Coupler Spline Grease	Propeller shaft splines	92-802869A1
F	Perfect Seal	Bearing carrier ends	92-34227-1
G	Bellows Adhesive	Seal water passage	92-86166Q1
H	Anti-Corrosion Grease	Propeller shaft	92-802867A1

Pre-Disassembly Inspection

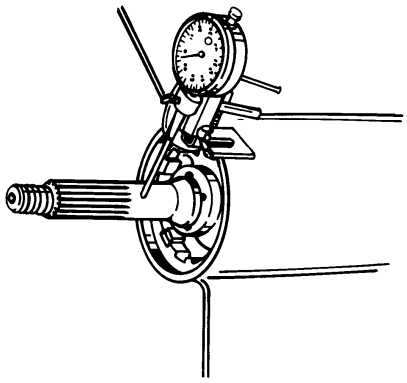
1. Remove propeller.



75492

a - Forward thrust hub
b - Flo-Torque drive hub
c - Propeller
d - Drive sleeve adapter
e - Tab washer
f - Nut

1. Position dial indicator on propeller shaft.
2. Push propeller shaft to one side and zero the dial indicator.
3. Move propeller shaft to opposite side while observing dial indicator.
4. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than 0.08 mm (0.003 in.) indicates one of the following:
   a. Worn propeller shaft bearings.
   b. Improper propeller shaft preload.



22086

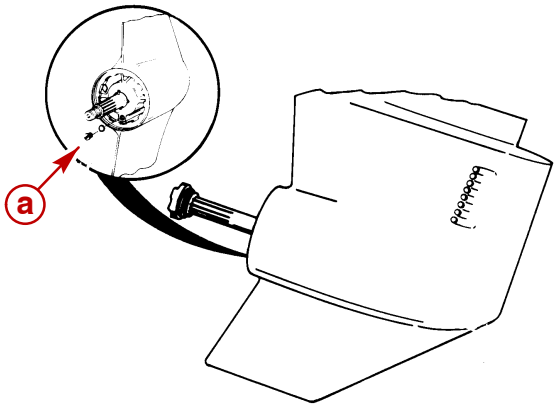
5. Rotate propeller shaft while observing dial indicator. If deflection is more than 0.178 mm (0.007 in.), a bent propeller shaft is indicated.

Drive Shaft Housing and Gear Housing Separation

⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

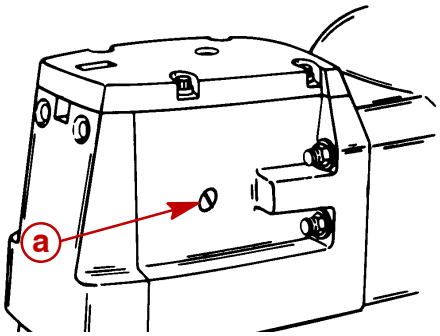
1. Remove, empty, and clean gear lube monitor.
2. Drain sterndrive unit.



76827

a - Fill/drain screw

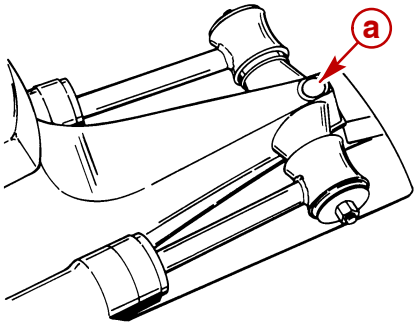
3. Remove vent plug.



76866

a - Vent plug

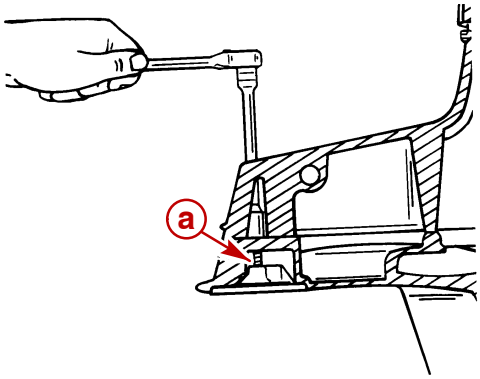
4. Remove rubber plug.



22093

a - Rubber plug

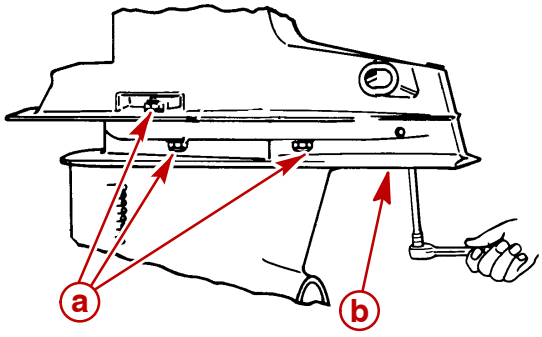
5. Remove anodic plate.



22258

a - 1/2 in. bolt

6. Remove gear housing from drive shaft housing.



76879

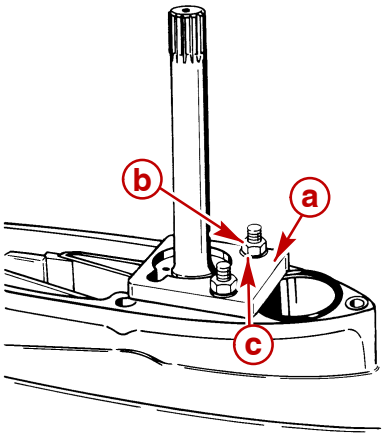
a - Nuts and washers (6)
b - Bolt (1)

Gear Housing Disassembly

⚠ CAUTION

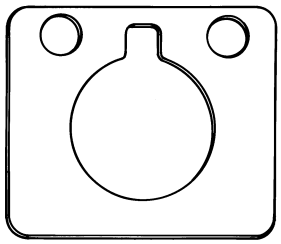
Clamp Plate (91-43559T) must be installed on gear housing when gear housing is separated from drive shaft housing.

1. Install Clamp Plate on gear housing. Place 2 washers on each side of the stud. Tighten nuts securely.

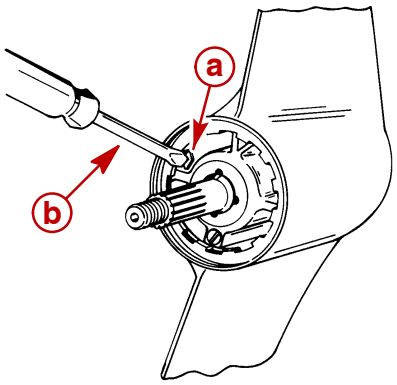


22439

a - Clamp Plate
b - Nut
c - Washer (2 per side)

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

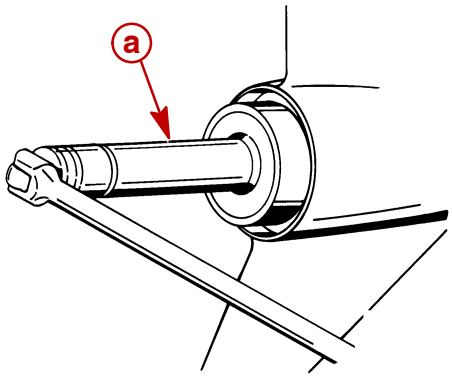
2. Bend tabs of tab washer away from bearing carrier retainer nut.



50136

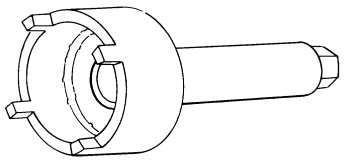
a - Tab
b - Screwdriver

3. Remove bearing carrier retainer nut using Bearing Carrier Retainer Nut Wrench.

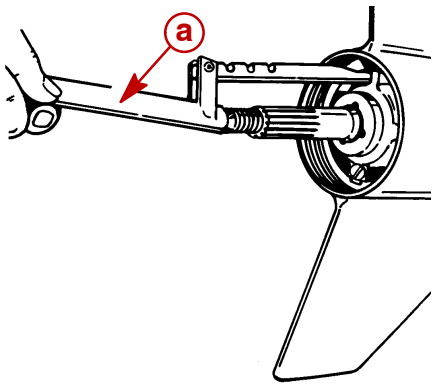


22112

a - Bearing Carrier Retainer Nut Wrench

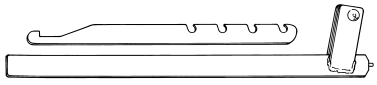
Bearing Carrier Retainer Nut Wrench		
 73605	Installs and removes the bearing carrier retainer nuts on the Bravo One, Two and Three sterndrive units.	91-61069T

4. Remove bearing carrier using Puller Bar.

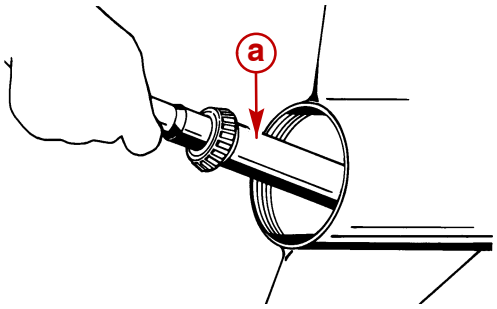


22104

a - Puller Bar

Puller Bar		
 73525	Removes the bearing carrier from all the Bravo One, Bravo Two, and all Bravo XR and XZ sterndrive units.	91-90338A1

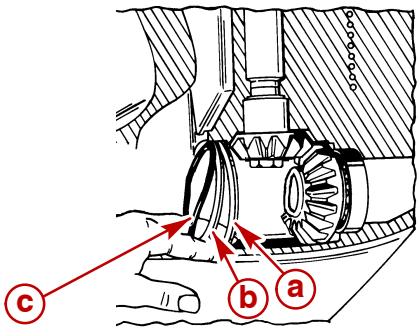
5. Remove propeller shaft.



22104

a - Propeller shaft

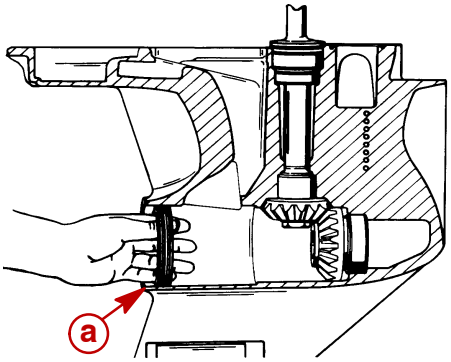
6. Remove washer, load ring, and O-ring.



79214

a - Washer
b - Load ring
c - O-ring

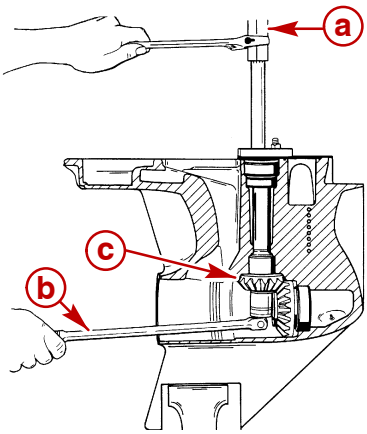
7. Temporarily reinstall bearing carrier retainer nut in gear housing to protect housing threads.



76870

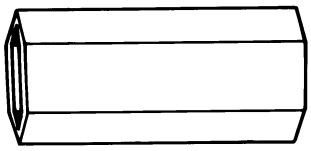
a - Bearing carrier retainer nut

8. Remove pinion gear, screw, and washer. Hold drive shaft using Drive Shaft Adapter.

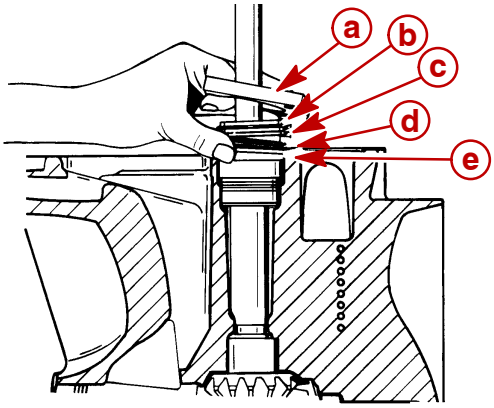


72246

a - Drive Shaft Adapter
b - Breaker bar and socket
c - Pinion gear

Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo and Blackhawk sterndrive units.	91-61077T

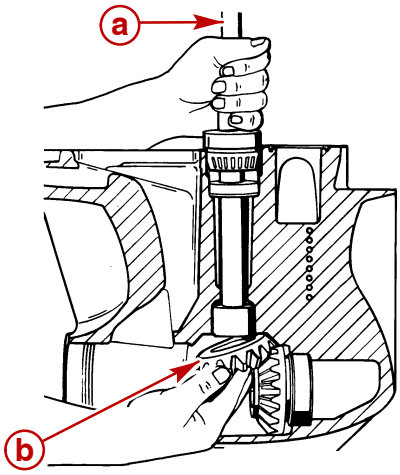
9. Remove Clamp Plate, then remove O-ring, spacer, shims, and tab washer. Retain shims for reassembly.



22262

a - Clamp Plate
b - O-ring
c - Spacer
d - Shims
e - Tab washer

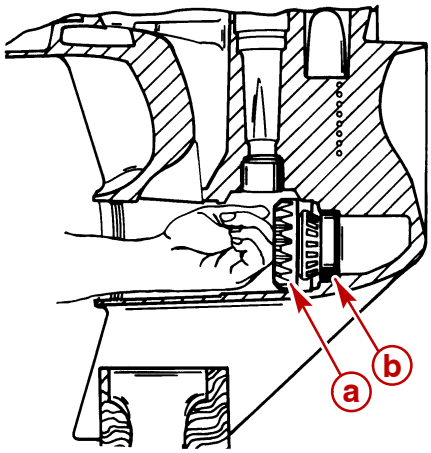
10. Remove drive shaft and pinion gear.



76871

a - Drive shaft
b - Pinion gear

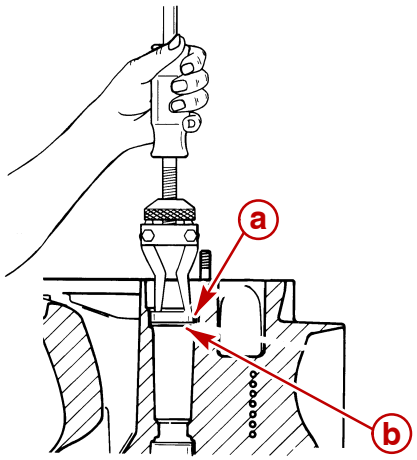
11. Remove driven gear and bearing.



22283

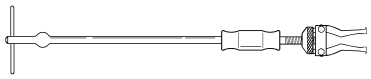
a - Driven gear
b - Bearing cup

12. Remove drive shaft bearing cup and shims using Slide Hammer Puller.

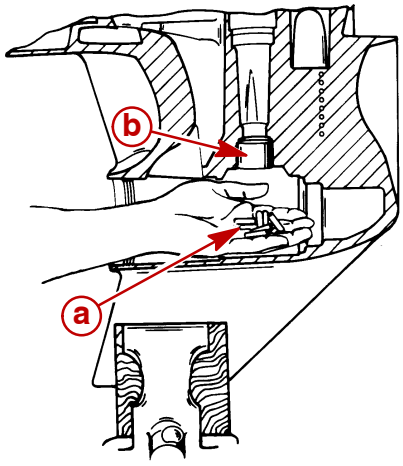


22261

a - Drive shaft bearing cup
b - Shims

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

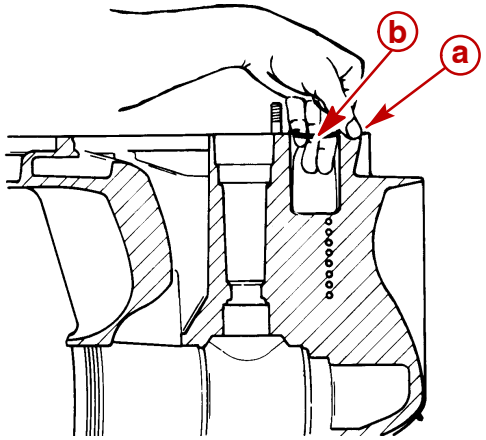
13. Unless you plan to remove the pinion bearing, remove needle bearings from drive shaft needle bearing race. (Refer to **Pinion Bearing Removal**)



22083

a - Needle bearings
b - Drive shaft needle bearing race

14. Remove water passage O-ring and oil passage quad ring.



22222

a - Water passage O-ring
b - Oil passage quad ring

Drive Shaft And Pinion Bearing

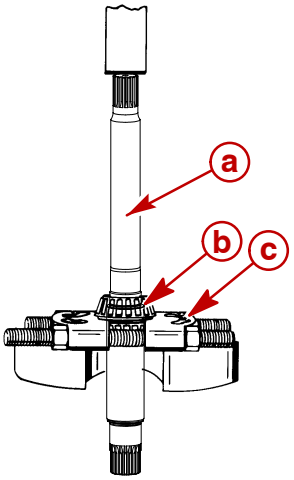
Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating or, has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replacement of drive shaft is necessary if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

NOTE: *Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removing.*

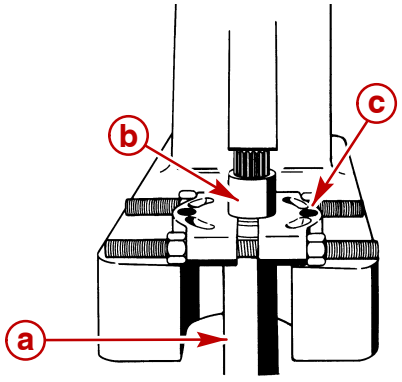
1. Press tapered roller bearing from shaft using Universal Puller Plate to support bearing. Remove second tapered roller bearing in same manner.



76872

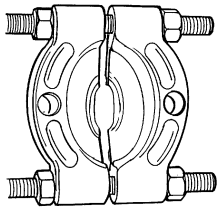
a - Drive shaft
b - Bearing
c - Universal Puller Plate

2. Press drive shaft pinion bearing inner race from drive shaft using the Universal Puller Plate.



76881

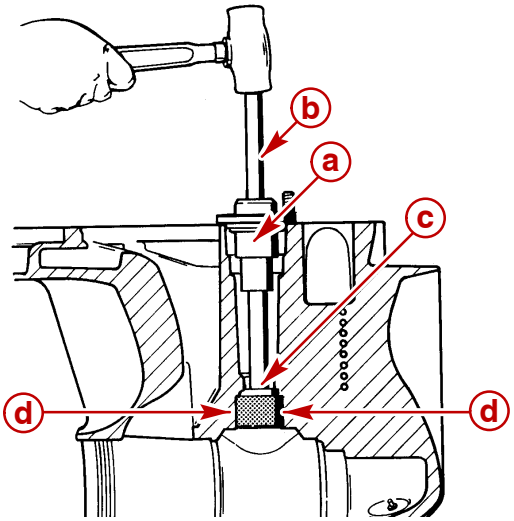
a - Drive shaft
b - Pinion bearing inner race
c - Universal Puller Plate

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Pinion Bearing Removal

IMPORTANT: All needle bearings MUST BE in place inside bearing casing while driving pinion bearing from gear case or bearing casing will bend or break and become difficult to remove.

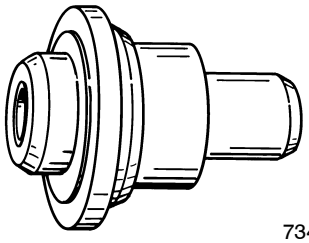
1. Heat area around bearing remover to approximately 93.3 degrees C (200 degrees F) to ease removal. Do not use open flame.
2. Remove pinion bearing using seal driver, Driver Head Rod, and Bearing Driver as a pilot.

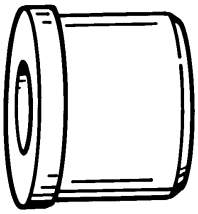


75902

a - Seal Driver - used as pilot
b - Driver Head Rod
c - Bearing Driver
d - Area around bearing

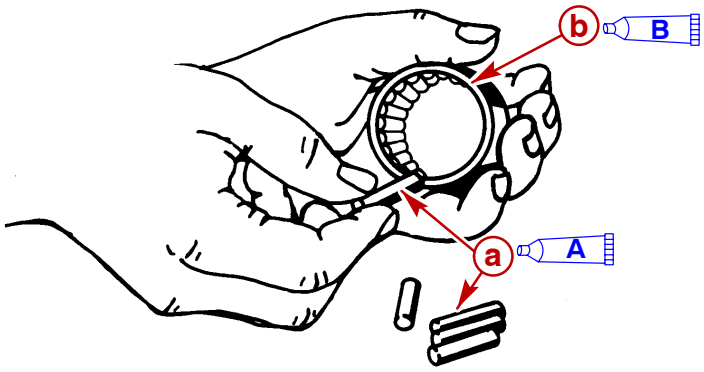
NOTE: *Driver Head Rod (91-37323) included in Bearing Removal and Installation Tool Assembly (91-31229A7).*

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

Bearing Driver		
 73447	Installs and removes the lower drive shaft pinion bearing on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-63638T

Pinion Bearing Installation

1. Install needles in casing. Use lubricant to help keep needles in place.
2. Position bearing assembly over bearing installation tool with number on bearing casing facing up.
3. Coat casing outside diameter with lubricant.

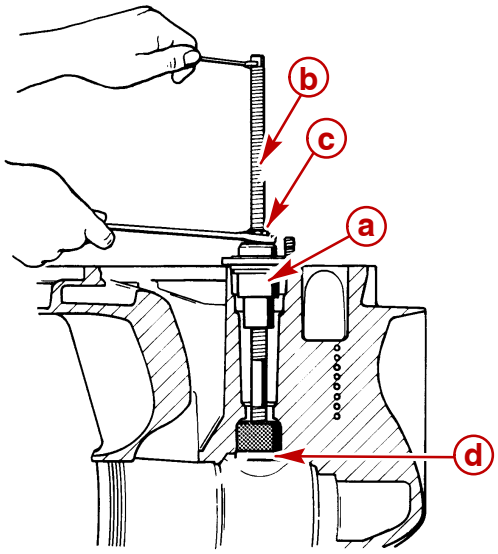


22219

a - Needle bearings
b - Casing

Description		Where Used	Part Number
A	Needle Bearing Assembly Lubricant	Needle bearings	92-808868A1
B	High-Performance Gear Lube	Outside casing diameter	92-802854A1

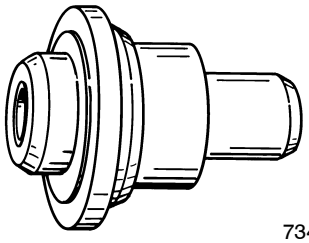
4. Install pinion bearing. Use the Seal Driver as a pilot.

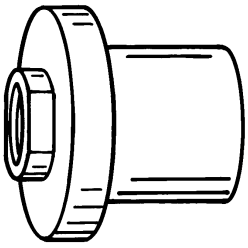


22222

a - Seal Driver - used as pilot
b - Puller Shaft
c - Washer and nut
d - Bearing Driver

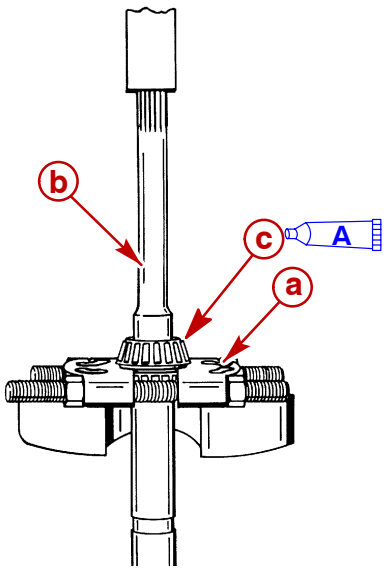
NOTE: *Puller Shaft 91-31229 included in Bearing Removal and Installation Tool Assembly 91-31229A7.*

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

Bearing Driver		
 73462	Installs the drive shaft needle bearings on all the Bravo sterndrive units.	91-89867T

Drive Shaft Reassembly

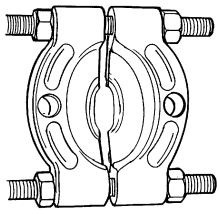
1. Lubricate inside diameter of tapered roller bearing.
2. Press small tapered roller bearing onto drive shaft using Universal Puller Plate.
3. Ensure that smaller outside diameter faces pinion end of shaft.



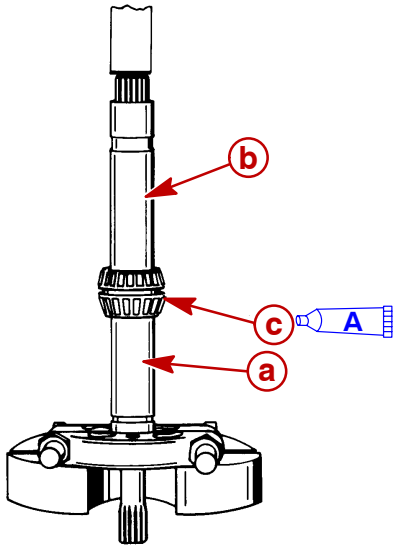
76873

a - Universal Puller Plate
b - Drive shaft
c - Small tapered roller bearing

Description		Where Used	Part Number
A	High Performance Gear Lube	Inner diameter of tapered roller bearing	92-802854A1

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

4. Lubricate inside diameter of tapered roller bearing.
5. Press large tapered roller bearing onto drive shaft using a suitable mandrel.
6. Ensure that larger outside diameter faces pinion end of shaft.



76874

a - Suitable mandrel on inner race of bearing
b - Drive shaft
c - Large tapered roller bearing

Description		Where Used	Part Number
A	High Performance Gear Lube	Inner diameter of tapered roller bearing	92-802854A1

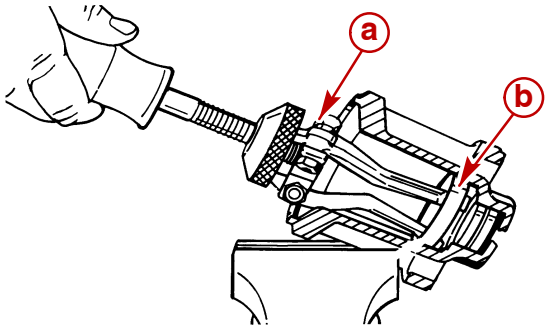
Bearing Carrier

Inspection

1. The condition of the propeller shaft tapered roller bearing cup is an indication of the condition of tapered roller bearing on propeller shaft. Replace bearing and cup if cup is pitted, grooved, scored, worn, uneven, discolored from overheating, or has embedded metal particles.
2. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.

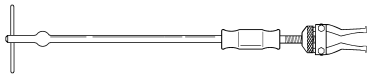
Bearing Carrier Disassembly

1. Remove bearing cup using Slide Hammer Puller.

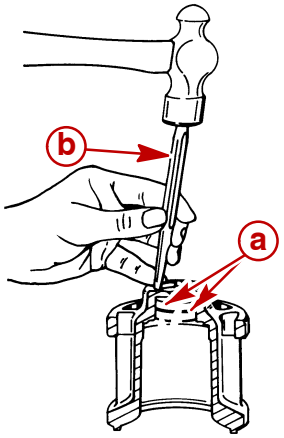


22087

a - Slide Hammer Puller
b - Bearing cup

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

2. Remove oil seals from bearing carrier using a hammer and punch.

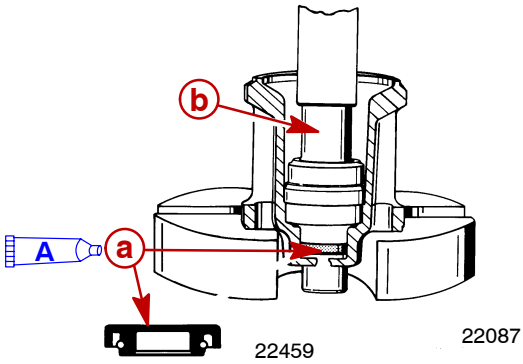


22111

a - Oil seals (2)
b - Punch

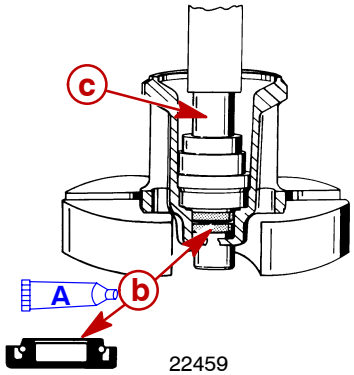
Bearing Carrier Reassembly

1. Coat outside diameter of oil seal with threadlocker.
2. Install outer oil seal with lip facing outward using the Bearing Carrier Seals And Bearing Cup Driver.
3. Coat outside diameter of oil seal with threadlocker.
4. Install inner oil seal with lip facing inward using the Bearing Carrier Seals And Bearing cup Driver.



22459

22087



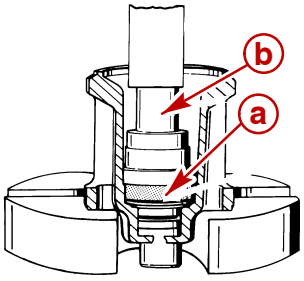
22459

22088

a - Oil seal - lip outward
b - Bearing Carrier Seals And Bearing Cup Driver
c - Oil Seal - lip inward

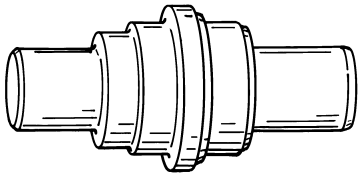
Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Outside diameter of oil seal	92-809819

5. Install bearing cup with bearing surface inward using the Bearing Carrier Seals And Bearing Cup Driver.



22088

a - Bearing cup
b - Bearing Carrier Seals And Bearing Cup Driver

Bearing Carrier Seals And Bearing Cup Driver		
 73463	Installs the bearing carrier seals on the Bravo One and Bravo Two sterndrive units.	91-89865

Propeller Shaft

Inspection

1. Check propeller shaft for bent condition.

LATHE AND DIAL INDICATOR METHOD:

1. Position propeller shaft centers in lathe.
2. Mount dial indicator at front edge of propeller shaft.
3. Rotate shaft and observe dial indicator. Movement of more than 0.178 mm (0.007 in,) is reason for replacement.

V-BLOCKS AND DIAL INDICATOR METHOD:

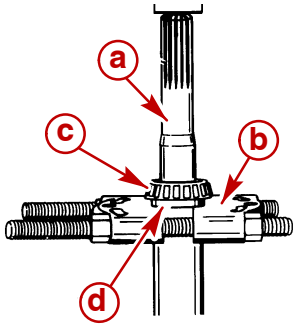
1. Position propeller shaft bearing surfaces on V-blocks.
2. Mount a dial indicator at front edge of propeller shaft.
3. Rotate shaft and observe dial indicator. Movement of more than 0.178 mm (0.007 in.) is reason for replacement.

ALL MODELS

1. Inspect for bent or twisted splines.
2. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Oil seals will have to be replaced if any grooves are found.

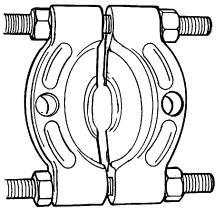
Propeller Shaft Bearing Removal

1. Press bearing from propeller shaft using Universal Puller Plate.



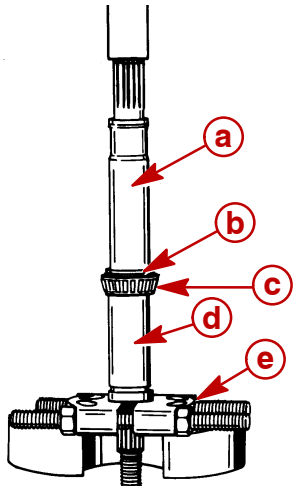
76875

a - Propeller shaft
b - Universal Puller Plate
c - Tapered roller bearing
d - Washer

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Propeller Shaft Bearing Installation

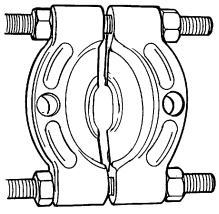
1. Apply lubricant to inside diameter of new tapered roller bearing.
2. Install bearing to shaft using Universal Puller Plate and a suitable mandrel (old bearing race) which supports bearing on inner race.
3. Press the bearing into place.



22110

a - Propeller shaft
b - Inner diameter
c - Tapered roller bearing
d - Suitable mandrel
e - Universal Puller Plate

Description	Where Used	Part Number
High Performance Gear Lube	Inside diameter of new bearing	92-802854A1

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

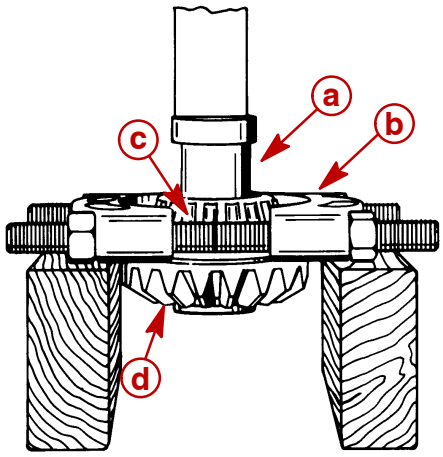
Driven Gear Bearing

Inspection

1. Remove bearing from driven gear. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth, and excessive or uneven wear. Replace both gears if any of these conditions exist.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scoured, worn uneven, discolored from overheating, or has metal particles embedded in the cup.

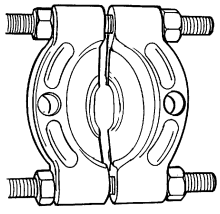
Driven Gear Bearing Removal

1. Remove bearing from driven gear using Universal Puller Plate.
2. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth, and excessive or uneven wear. Replace both gears if any of these conditions exist.



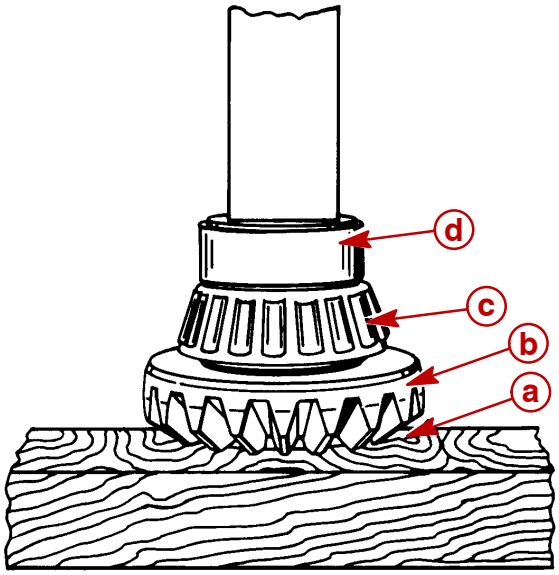
22108

a - Suitable mandrel
b - Universal Puller Plate
c - Bearing
d - Driven gear

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Driven Gear Bearing Installation

1. Apply a light coat of lubricant to inside diameter of new bearing.
2. Place a suitable mandrel or old bearing race against new bearing race.
3. Place another mandrel on face of gear and press gear and bearing together.



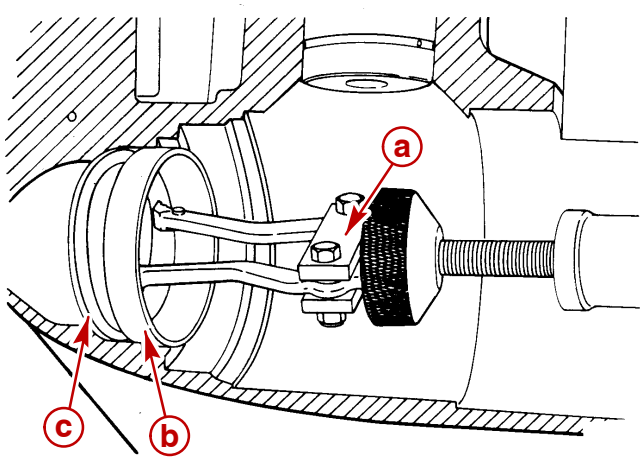
22108

a - Hard wood or metal block
b - Driven gear
c - Tapered roller bearing
d - Mandrel - on inner bearing race

Description	Where Used	Part Number
High Performance Gear Lube	Inside diameter of new bearing	92-802854A1

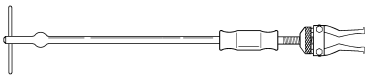
Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims using Slide Hammer Puller.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has metal particles embedded in the cup.



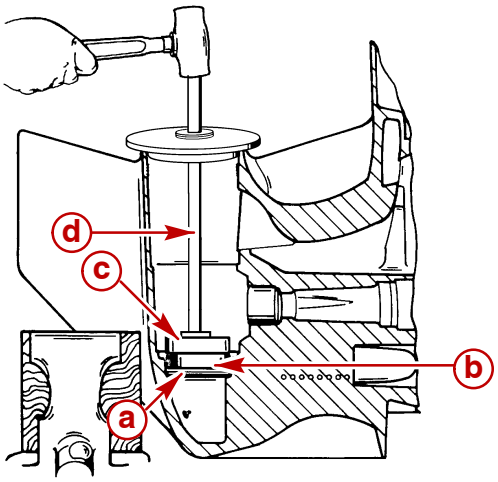
19808

a - Slide Hammer Puller
b - Bearing cup
c - Shims

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

Driven Gear Bearing Cup Installation

1. Install driven gear bearing cup with original thickness shims using Bearing Cup Driver. Ensure that cup is not canted. Coat bearing cup outside diameter with lubricant.

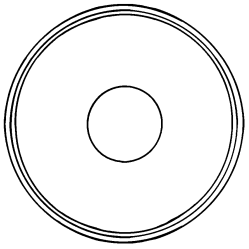


75922

a - Shims
b - Bearing cup
c - Bearing Cup Driver
d - Old propeller shaft or driver rod

NOTE: *If an MC-I propeller shaft is not available, use Driver Rod 91-37323 (from Bearing Removal and Installation Kit, 91-31229A7.*

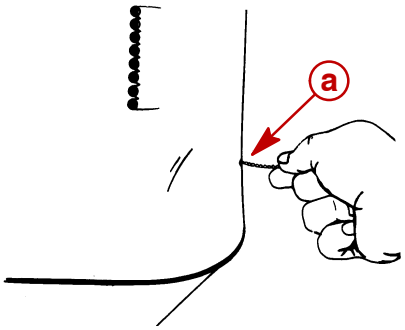
Description	Where Used	Part Number
High Performance Gear Lube	Outside diameter of bearing cup	92-802854A1

Bearing Cup Driver		
 74189	Installs the driven gear bearing cup on the Bravo One and Bravo Two sterndrive units.	91-31106T

Speedometer Water Passage

Pickup Inspection and Cleaning

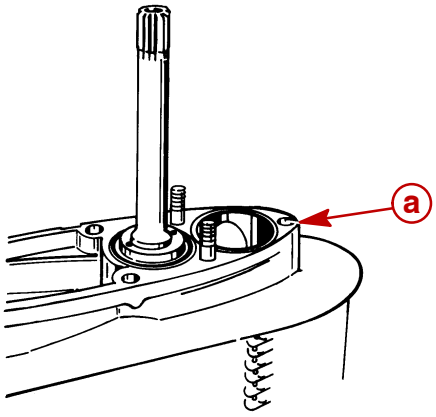
1. Inspect opening (pitot tube) on leading edge of gear housing for obstruction.
2. Clean opening with a short piece of wire. If obstruction cannot be removed with wire, carefully reopen tube using a 2 mm (5/64 in.) diameter drill bit. Do not drill beyond a depth of 62 mm (2-7/16 in.).



22462

a - Pitot tube

3. Inspect water passage seal for nicks, cuts, or distortion. Replace if necessary.

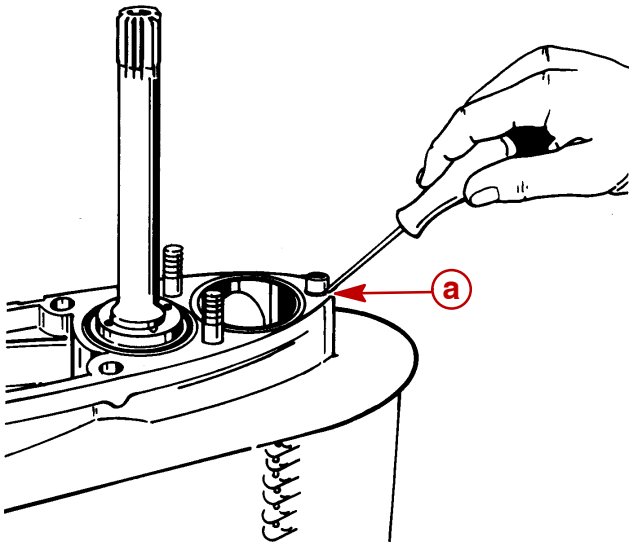


22085

a - Water passage seal

Water Passage Seal Replacement

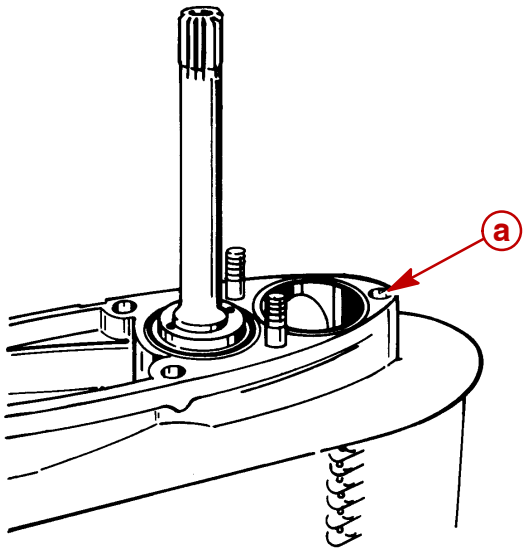
1. Pry seal out with a suitable tool.



22085

a - Seal

2. Lightly coat outside diameter of seal with adhesive and install in speedometer water passage bore. Ensure that top edge of seal is flush with gear housing surface.



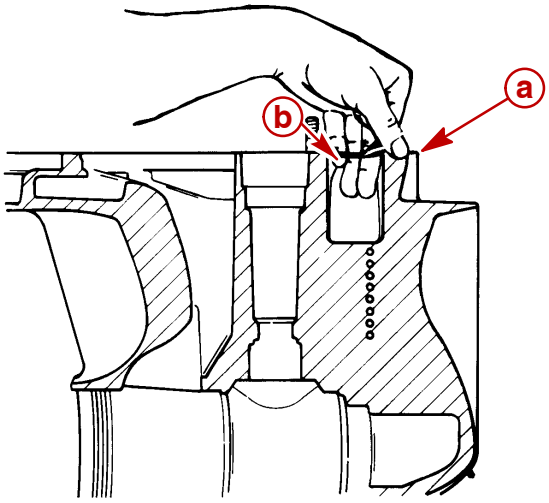
22085

a - Seal

Description	Where Used	Part Number
Bellows Adhesive	Outer diameter of seal	92-86166Q1

Gear Housing Reassembly And Shimming

1. Lubricate all bearings. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using adhesive.

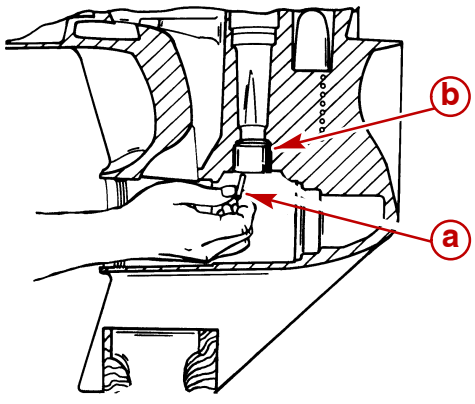


22222

a - O-ring
b - Oil passage quad ring

Description	Where Used	Part Number
High Performance Gear Lube	All bearings	92-802854A1
Bellows Adhesive	Water passage O-ring and oil passage quad ring	92-86166Q1

3. Install needle bearings into lower needle bearing casing. Use lubricant to hold needle bearings in place.

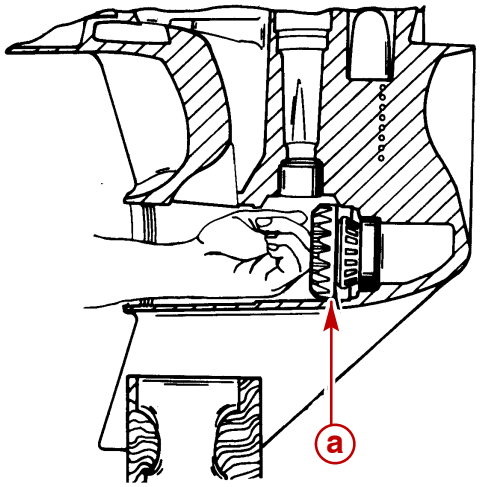


22083

a - Needle bearings
b - Needle bearing casing

Description	Where Used	Part Number
Needle Bearing Assembly Lubricant	Needle bearings	92-802868A1

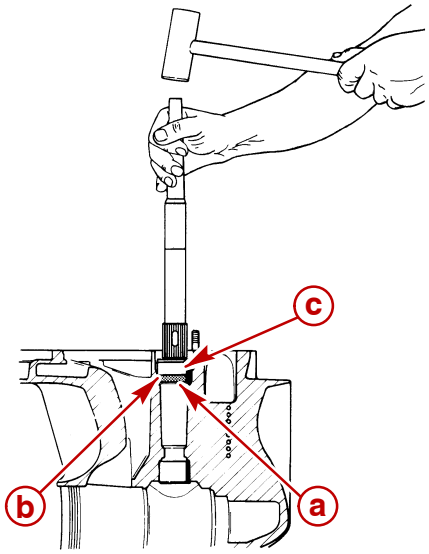
4. Install driven gear assembly.



22083

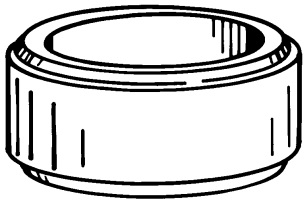
a - Driven gear assembly

5. Install original thickness shims and drive shaft lower bearing cup using Bearing Cup Driver. Use original shims or, if misplaced, start with 0.050 in. (1.27 mm) thickness.

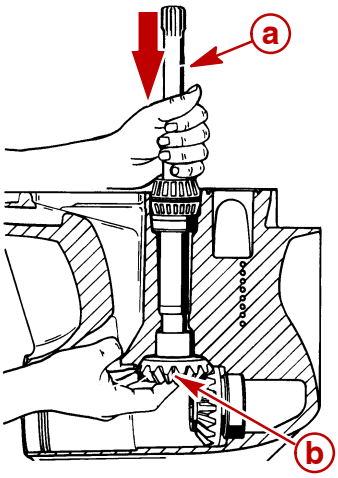


50409

a - Shims
b - Lower bearing cup
c - Bearing Cup Driver

Bearing Cup Driver		
 73460	Installs the drive shaft bearing cup in the gear housing and bearing cup in the bearing carrier of the Bravo One and Bravo Two sterndrive units.	91-67443T

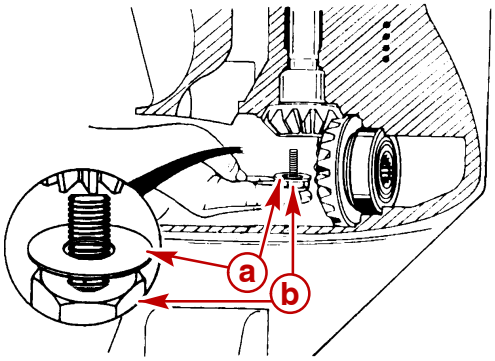
6. Install drive shaft and pinion gear.



22258

a - Drive shaft
b - Pinion gear

7. Install pinion washer and screw. Apply threadlocker to threads of screw.



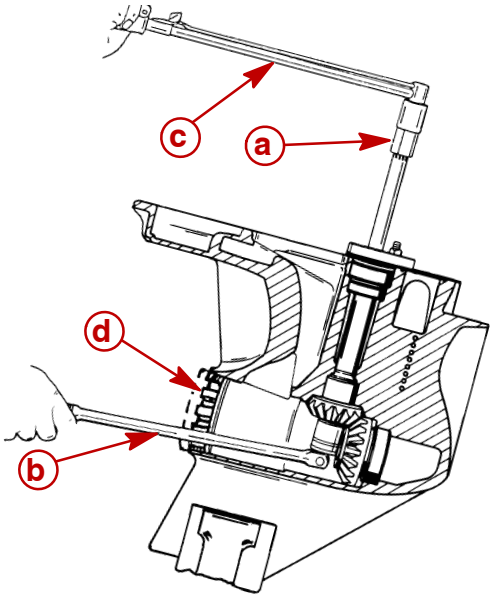
76877

a - Washer
b - Screw

Description	Where Used	Part Number
Loctite 271 Threadlocker	Threads of screw	92-809819

8. Temporarily install bearing carrier retaining nut to prevent damage to threads.
9. Torque pinion screw.

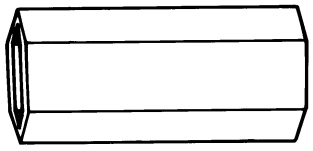
NOTE: *Position gear housing nose down to prevent driven gear assembly from falling out.*



22260

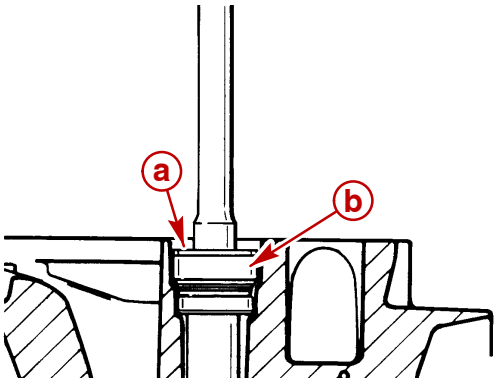
a - Drive Shaft Adapter
b - Breaker bar and socket
c - Torque wrench and socket
d - Bearing carrier retainer

Description	Nm	lb-in.	lb-ft
Drive shaft pinion screw	61		45

Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo and Blackhawk sterndrive units.	91-61077T

10. Remove bearing carrier retainer nut previously placed in unit for protection of threads.

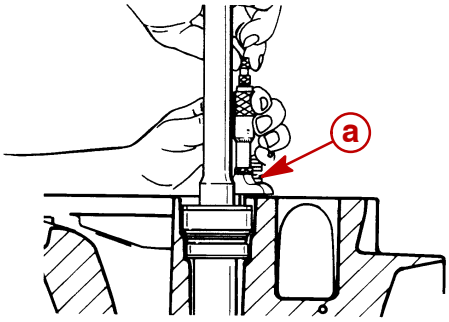
11. Install upper bearing cup and tab washer.



a - Tab washer
b - Upper bearing cup

12. Determine shim thickness required for drive shaft bearing preload using the following procedure or use original thickness shims.

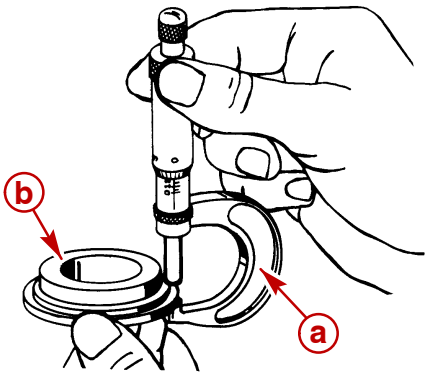
    a. Measure distance between top of gear housing and tab washer in 2 places using a 0-25 mm (0-1 in.) depth micrometer.



22259

a - Depth micrometer
b - Tab washer

    b. Measure thickness of spacer from top machined surface to bottom machined surface.



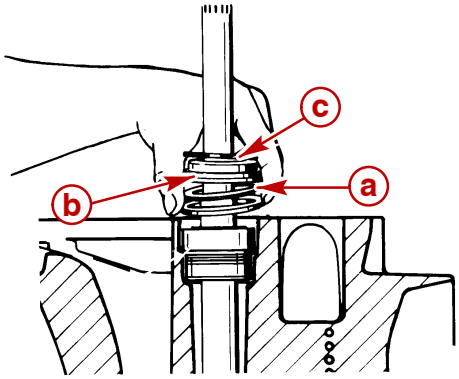
22100

a - Outside micrometer
b - Spacer

c. Calculate shim thickness as shown.

Measurement from Step a. –(Measurement from Step b + 0.0254 mm {0.001 in.}) Shim Thickness Required.

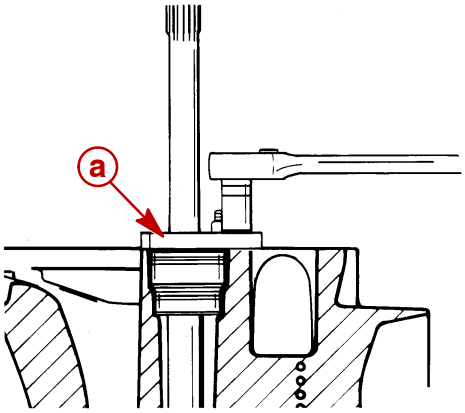
13. Install shims, spacer, and O-ring.



22259

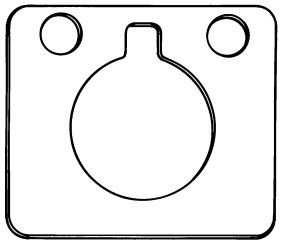
a - Shims
b - Spacer
c - O-ring

14. Install Clamp Plate on gear housing with 2 nuts and 4 washers and torque.



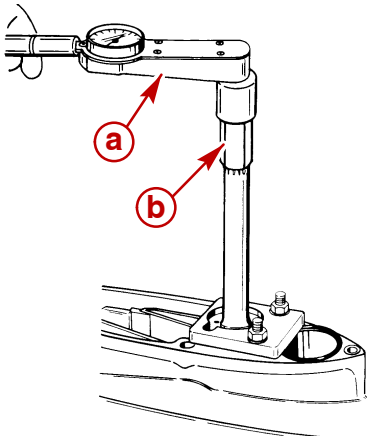
22262

a - Clamp plate

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

Description	Nm	lb-in.	lb-ft
Clamp Plate	47		35

15. Using a dial-type lb-in. torque wrench, check the rolling preload by turning drive shaft with a slow steady motion.



50410

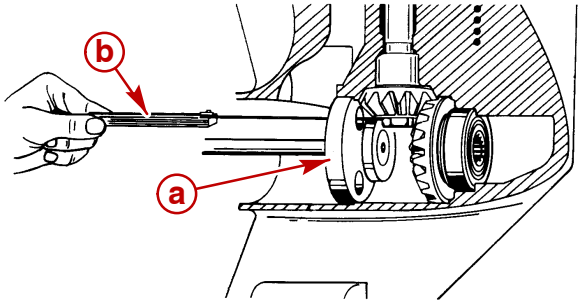
a - Torque wrench
b - Drive shaft adapter

Description	Nm	lb-in.	lb-ft
Rolling preload of drive shaft	0.3-0.6	3-5	

16. If preload is incorrect, adjust by adding or subtracting shims from upper tapered roller bearing cup. Reinstall clamp plate and recheck preload. Record final preload.

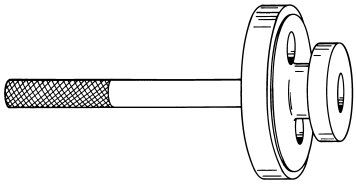
Description	Nm	lb-in.	lb-ft
Rolling preload of drive shaft	0.3-0.6	3-5	

17. Check pinion height.
    a. Rotate drive shaft several times to seat bearings.
    b. Insert Drive Shaft Pinion Gear Shimming Tool into gear housing.
    c. Measure clearance between tool and pinion gear with feeler gauge and shimming tool. Take measurement at 3 locations on pinion gear (120 degrees apart).



76878

a - Shimming Tool
b - Feeler gauge

Drive Shaft Pinion Gear Shimming Tool		
 73454	Shims the pinion gear on the Bravo One sterndrive units.	91-42840T

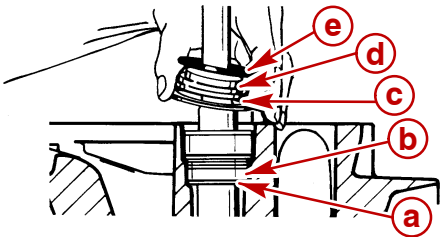
Description	mm	in.
Pinion gear clearance	0.635	0.025

d. If clearance is less than specified, add appropriate thickness of shims under lower tapered roller bearing cup.

Any thickness added here must be subtracted from shim thickness at upper bearing.

If clearance is more than specified, remove appropriate thickness of shims from under lower tapered roller bearing cup**.**

Any thickness subtracted here must be added to shim thickness at upper bearing.

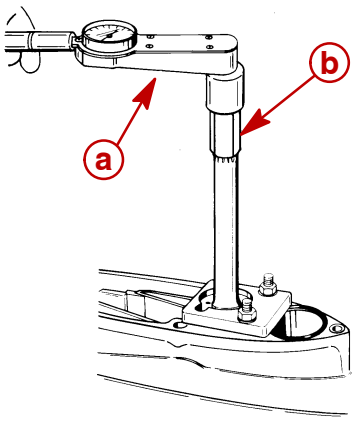


22262

a - Lower shims
b - Lower bearing cup
c - Upper shims
d - Spacer
e - O-ring

e. Recheck clearance after changing shims.

18. Using a dial-type lb-in. torque wrench, recheck the rolling preload by rotating drive shaft with a slow steady motion.

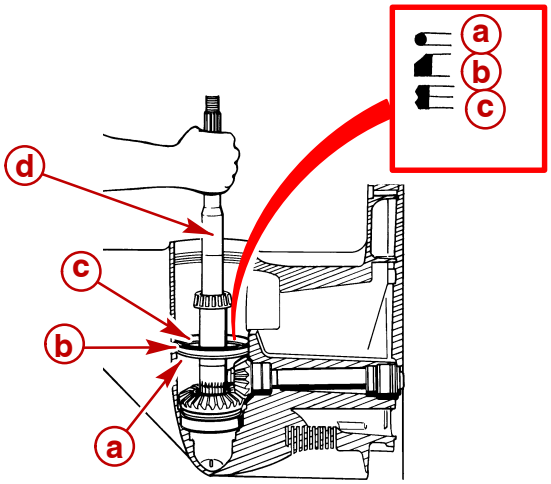


50410

a - Torque wrench
b - Drive Shaft Adapter

Description	Nm	lb-in.	lb-ft
Rolling preload of drive shaft	0.3-0.6	3-5	

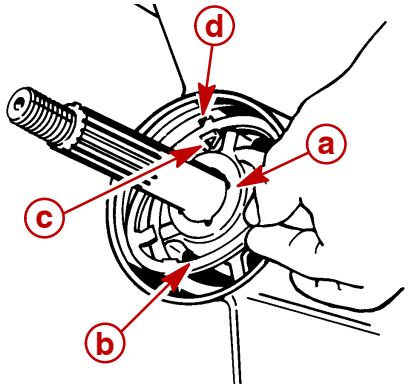
19. Install the original load ring, thrust ring, O-ring, and propeller shaft into the gear housing.



76883

a - O-ring
b - Thrust ring
c - Load ring
d - Propeller shaft

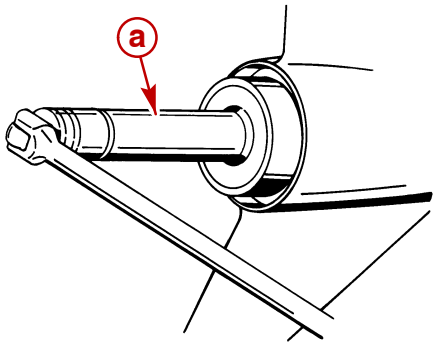
20. Install bearing carrier and tab washer. Align inner tab of tab washer with V-notch in bearing retainer.



23257

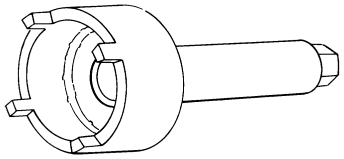
a - Bearing carrier
b - Tab washer
c - Inner tab
d - Outer tab

21. Install and tighten bearing carrier retaining nut using Retainer Wrench until resistance to propeller shaft rotation can be felt to preload bearings and eliminate end play.

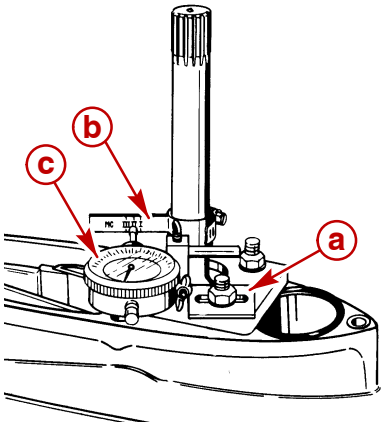


22112

a - Bearing Carrier Retainer Nut Wrench

Bearing Carrier Retainer Nut Wrench		
 73605	Installs and removes the bearing carrier retainer nuts on the Bravo One, Two, and Three sterndrive units.	91-61069T

22. Driven gear shimming:



22439

a - Dial Indicator Adapter
b - Backlash Indicator Rod
c - Dial Indicator

a. Install Dial Indicator Adapter Kit, Backlash Indicator Rod And Dial Indicator Set. Install dial indicator adapter kit, backlash indicator rod, and dial indicator set. Ensure that dial rod is aligned with “II” on indicator rod.

b. Check gear backlash by lightly rotating drive shaft 120 degrees. Do not allow the propeller shaft to turn during this procedure.

c. Observe dial indicator, and record readings at three 120 degree increments.

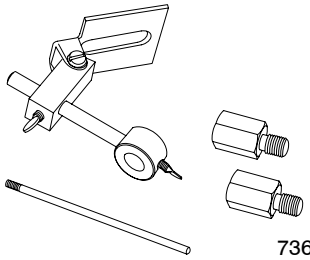
d. Average the 3 readings.

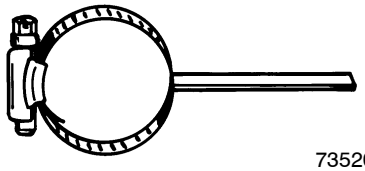
e. If backlash is not correct, disassemble and proceed as follows:

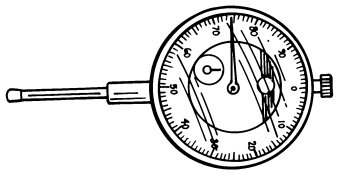
f. If backlash is more than specified: add shims under driven gear bearing cup. If backlash is less than specified: remove shims under driven gear bearing cup.

g. Recheck backlash reading after reassembly.

Description	mm	in.
Gear backlash	0.30-0.38	0.012-0.015

Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two, and Bravo Three sterndrive units.	91-83155

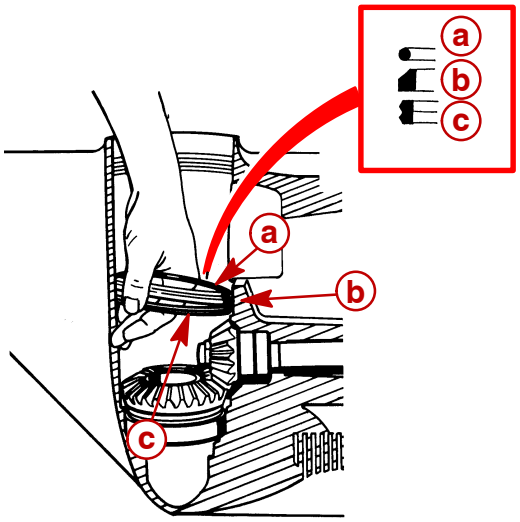
Backlash Indicator Rod		
 73520	Indicates the inner propeller shaft backlash on the Bravo Three and Blackhawk sterndrive units.	91-805481

Dial Indicator		
 73429	Measures the gear backlash on all the Alpha and Bravo sterndrive units.	91-58222A1

23. Remove bearing carrier, O-ring, thrust ring, and load ring.

24. Reinstall load ring,thrust ring,O-ring, and bearing carrier using a new load ring.

IMPORTANT: Always use a new load ring for final assembly.



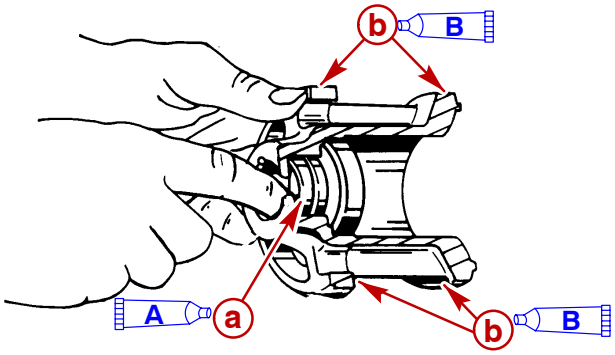
76884

a - O-ring
b - Thrust ring
c - Load ring

IMPORTANT: Bearing carrier and threads on retainer must be lubricated to prevent corrosion and cracking in gear housing.

Description	Where Used	Part Number
Special Lubricant 101	Retainer threads	92-802865A1
Perfect Seal	Outside diameter on carrier mating surfaces	92-34227-1

25. Lubricate bearing carrier seals and fill space between seals and carrier mating surfaces.



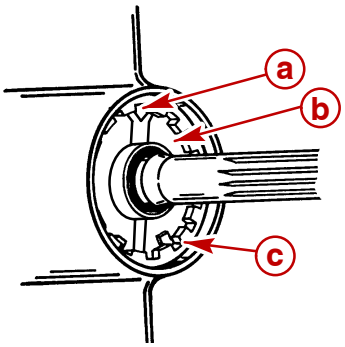
22111

a - Space between seals
b - Mating surfaces

Description		Where Used	Part Number
A	2-4-C with Teflon	Bearing carrier seals and spaces between seals	92-802859A1
B	Perfect Seal	Carrier mating surfaces	92-34227-1

26. Install bearing carrier and tab washer in gear housing. Align inner tab of tab washer with V-notch in bearing retainer and outer tab with hole in gear housing.

27. Lubricate threads on bearing carrier retaining nut. Install and tighten bearing carrier retainer nut until resistance to propeller shaft rotation can be felt to preload bearings.



a - Tab washer - V-notch in recess in carrier
b - Bearing carrier
c - Bearing carrier retainer nut

Description	Where Used	Part Number
Special Lubricant 101	Threads on bearing carrier retaining nut	92-802865A1

28. To determine overall gear case preload, add propeller shaft bearing preload (previously recorded) to drive shaft bearing preload as outlined in the example below.

IMPORTANT: The overall preload includes both the drive shaft preload and the gear case preload.

Description	New	Used[1]
Propeller Shaft Bearings Preloads	0.9-1.4 Nm (8-12 lb.-in.)[2]	0.6-0.9 Nm (5-8 lb.-in.)[2]
Drive Shaft Bearings	0.3-0.5 Nm. (3-5 lb-in.)	

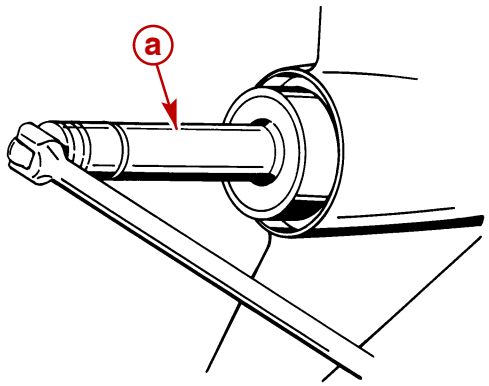
[1] *Bearing is considered used if spun under load even once ("under load" meaning: with power applied).*
[2] *Plus drive shaft preload of 0.3-0.6 Nm (3-5 lb-in.).*

Example:

Drive Shaft Preload	0.3 Nm (3 lb-in.)
	+
New Bearing Preload	0.9 Nm (8 lb-in.)
	1.2 Nm (11 lb-in.)

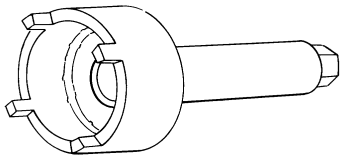
29. Tighten the retainer to the proper preload using the following procedure.

a. Tighten retainer nut in small increments using Retainer Wrench.

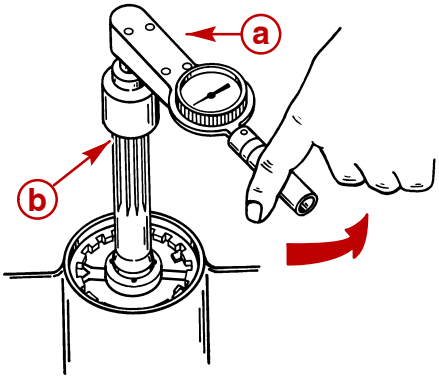


22112

a - Bearing Carrier Retainer Nut Wrench

Bearing Carrier Retainer Nut Wrench		
 73605	Installs and removes the bearing carrier retainer nuts on the Bravo One, Two, and Three sterndrive units.	91-61069T

b. Using a torque wrench, check overall gear housing bearing preload by rotating propeller shaft in direction of normal rotation with a slow steady motion.

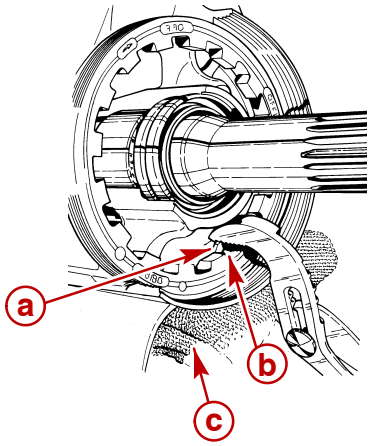


75924

a - Torque wrench
b - Propeller nut (under socket)

c. Continue tightening bearing carrier retainer nut and checking preload until specified bearing preload is attained.

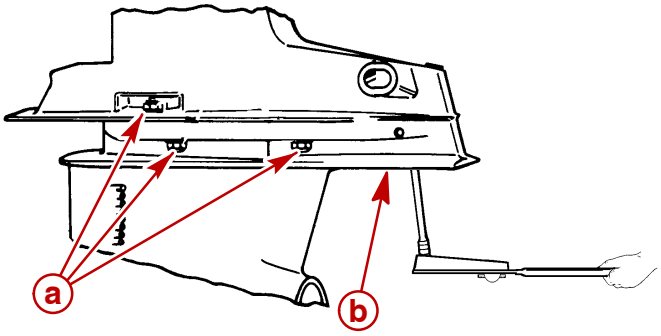
30. Bend one tab of tab washer into retaining nut as shown after propeller shaft preload has been set correctly. Bend remaining tabs down into gear housing. Cushion housing to avoid chipping or scratching paint.



19831

a - Tab washer tab
b - Groove in retainer
c - Cushioning

31. Install gear housing to drive shaft housing.

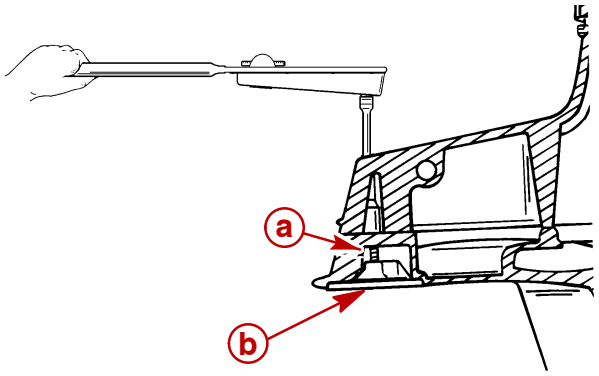


76879

a - Nuts and washers (3 each side)
b - Bolt (located in anodic plate cavity)

Description	Nm	lb-in.	lb-ft
Gear housing to drive shaft housing nuts and bolts	47		35

32. Install anodic plate and torque bolt.

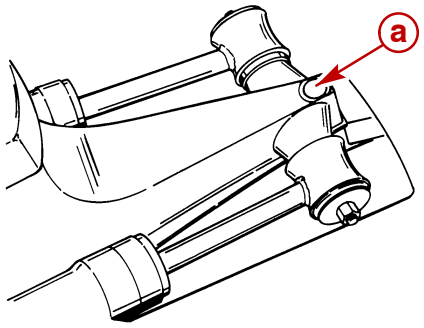


76880

a - Bolt
b - Anodic plate

Description	Nm	lb-in.	lb-ft
Anodic plate bolt	27		20

33. Install rubber plug.



22093

a - Rubber plug

34. Reinstall sterndrive unit. Refer to **Section 2A - Removal, Installation, and Adjustments**.
35. Fill sterndrive unit. Refer to **Section 1B - Maintenance**.

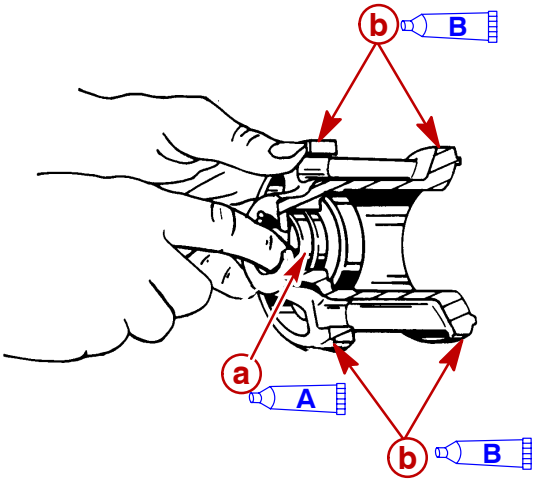
Bravo XZ and XR Heavy Duty Propeller Shaft

Gear Housing Disassembly/Reassembly

For disassembly and reassembly of Bravo XZ and XR gear housings refer to instructions for standard Bravo One gear housing. Procedures and specifications are identical except for installation of bearing carrier, bearing carrier retainer nut, and propeller hub.

Installing The Bearing Carrier

1. Lubricate bearing carrier seals. Coat carrier mating surfaces with sealant. Lubricating bearing carrier and threads on retainer will help prevent corrosion and cracking in gear housing.

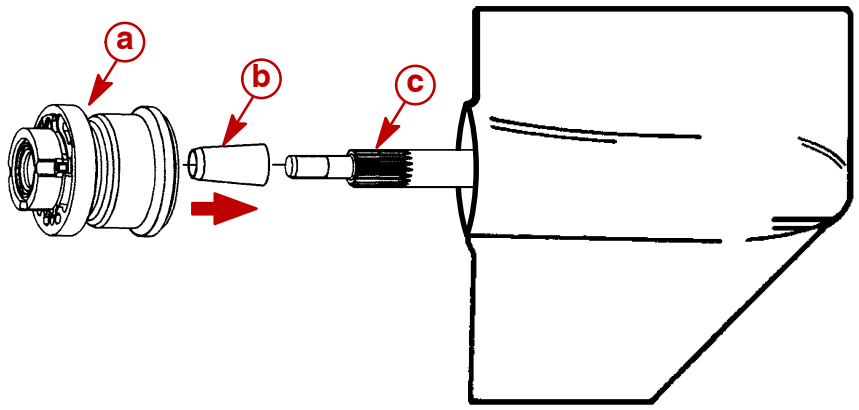


22111

a - Space between seals
b - Mating surfaces

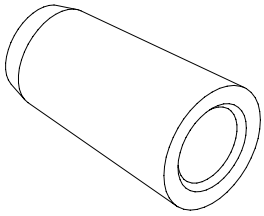
Description		Where Used	Part Number
A	2-4-C with Teflon	Bearing carrier seals and spaces between seals	92-802859A1
B	Perfect Seal	Carrier mating surfaces	92-34227-1

2. Position bearing carrier installation tool onto prop shaft.
3. Slide bearing carrier over Installation Tool and insert tab washer in gear housing. Position inner tab in V-notch.

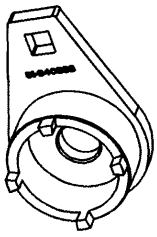


77110

a - Bearing carrier assembly
b - Bearing Carrier Installation Tool
c - Heavy duty prop shaft

Bearing Carrier Installation Tool		
 78070	Installs the bearing carrier on the Bravo One with High Performance Propeller Shaft Kit installed on the lower unit and the Bravo XZ and XR sterndrive units.	91-840388

4. Use Bearing Carrier Retainer Nut Wrench to tighten bearing carrier retainer nut.

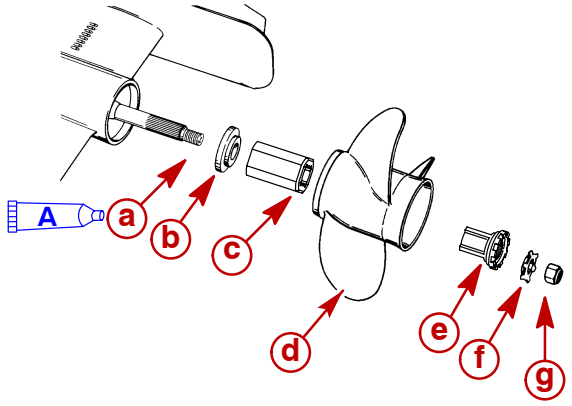
Bearing Carrier Retainer Nut Wrench		
 78059	Installs the bearing carrier retainer nut on the Bravo One with High Performance Propeller Shaft Kit installed on the lower unit and Bravo XZ and XR sterndrive units. Bearing Carrier Retainer Nut Wrench included with Propeller Shaft Tool Kit 91-840393A1.	91-840393

Installing The Standard Propeller Hub Assembly

NOTE: *Propeller Hub Assembly 91-840389A1 will fit both long A45, A55 and short A46, A56 bore hub propellers.*

IMPORTANT: Correct rotation propeller MUST match direction of rotation of propeller shaft.

1. Install propeller with attaching hardware.
2. Apply lubricant on splines of propeller shaft.
3. Torque the nut, then continue to tighten until 3 tabs on the tab washer align with grooves on spline washer. Bend the 3 tabs down into grooves.



78662

a - Propeller shaft splines
b - Forward thrust hub
c - Flo-Torque drive hub
d - Propeller
e - Drive sleeve adapter
f - Tab washer
g - Locknut

Description	Where Used	Part Number
Special Lubricant 101	Propeller shaft	92-802865A1
2-4-C with Teflon		92-802859A1
Anti-Corrosion Grease		92-802867A1

Description	Nm	lb-in.	lb-ft
Propeller locknut	75		55
	Then align tabs with grooves.		

NOTES:

STERNDRIVE UNIT

Section 3C - Bravo Two Gear Housing

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3 C

Specifications

Bearing Preloads

Description	Nm	lb-in.
Rolling Preload of Drive Shaft bearing	0.3-0.6	3-5
Overall Preload Checked at Inner Propeller Shaft (New Bearings)	0.9-1.14[1]	8-12[1]
Overall Gear Case Preload Checked at Inner Propeller Shaft (Used Bearings)[2]	0.6-0.9[1]	5-8[1]

[1] *DOES NOT include 0.3-0.6 Nm (3 to 5 lb-in.) on drive shaft.*

[2] *A bearing is used if spun once under load.*

Gear Backlash

Description	mm	in.
Gear backlash	0.28-0.38	0.009-0.015

Pinion Gear Clearance

Description	mm	in.
Pinion gear clearance	0.635	0.025

Gear Ratio - Teeth per Gear (Gear Housing)

Ratio	Drive	Driven
2.20:1	16	27
2.00:1	16	27
1.81:1	16	27
1.65:1	18	25
1.50:1	18	25

Torque Specifications

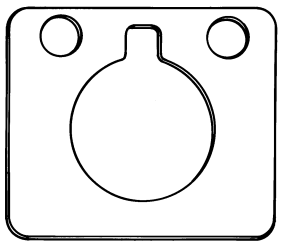
NOTE: *Securely tighten all fasteners not listed below.*

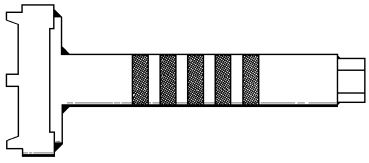
Description	Nm	lb-in.	lb-ft
Pinion nut	136		100
Clamp plate	47		35
Anodic plate screw	27		20
Gear housing to drive shaft housing fasteners	47		35
Propeller locknut	75		55

Lubricants / Sealants / Adhesives

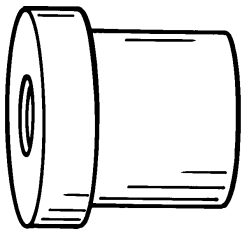
Description	Where Used	Part Number
Anti-Corrosion Grease	Propeller shaft	92-802867A1
Special Lubricant 101	Propeller shaft splines	92-802865A1
	Bearing carrier retainer	
Perfect Seal	Carrier mating surfaces	92-34227-1
Needle Bearing Assembly Lubricant	Needle bearings	92-808868A1
2-4-C with Teflon	Propeller shaft	92-802859A1
	Bearing carrier seals and spaces between seals	
Loctite 271 Threadlocker	Outside diameter of oil seal	92-809819
	Threads of pinion bolt	
3M Brand Adhesive	Water passage O-ring and oil passage quad ring	92-86166Q1
	Outer diameter of seal	
High Performance Gear Lube	All bearing surfaces	92-802854A1
	Tapered roller bearing	
	Inside diameter of tapered roller bearing	
	Outside casing diameter	

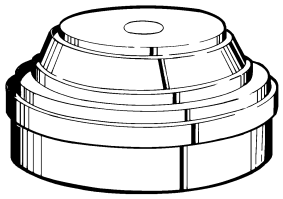
Special Tools

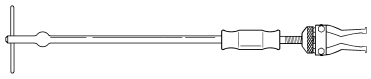
Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

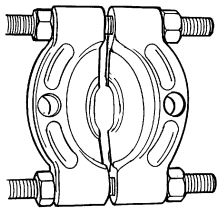
Bearing Carrier Retainer Tool		
 74194	Loosens and tightens the bearing carrier retainer on the Bravo Two sterndrive units.	91-17257

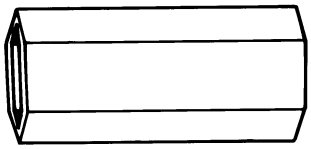
Special Tools (continued)

Bearing Driver		
 73466	Installs the needle bearings in the Bravo One, Bravo Two, and Bravo Three sterndrive unit bearing carriers.	91-55918

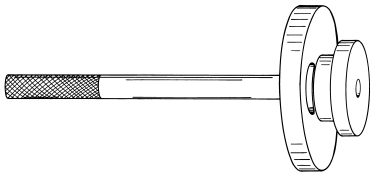
Bearing Cup Driver		
 73646	Installs the bearing cup in the Bravo Two bearing carriers.	91-63626

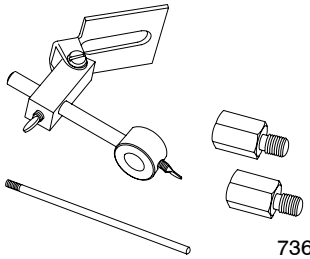
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

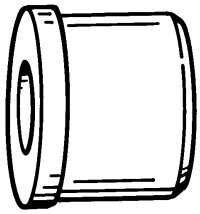
Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

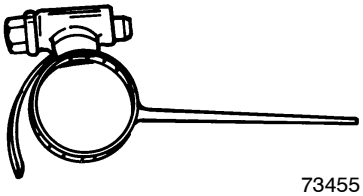
Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo and Blackhawk sterndrive units.	91-61077T

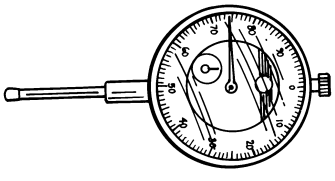
Special Tools (continued)

Gear Case Pinion Shimming Tool		
 73457	Measures the pinion height on the Bravo Two gear case.	91-96512

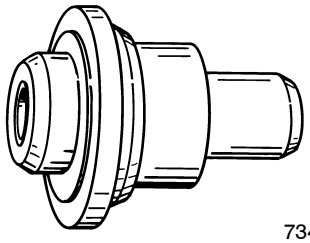
Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two, and Bravo Three sterndrive units.	91-83155

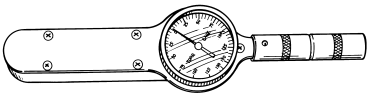
Bearing Driver		
 73447	Installs and removes the lower drive shaft pinion bearing on the Bravo One, Bravo Two, and Bravo Three sterndrive units.	91-63638T

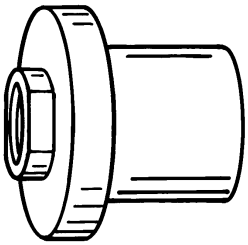
Backlash Indicator Rod		
 73455	Checks the gear backlash on the Bravo One and Bravo Two sterndrive units.	91-53459

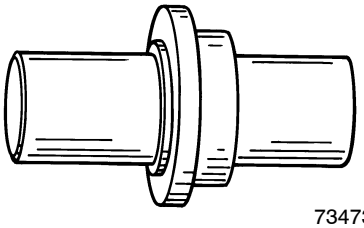
Dial Indicator		
 73429	Measures the gear backlash on all the Alpha and Bravo sterndrive units.	91-58222A1

Special Tools (continued)

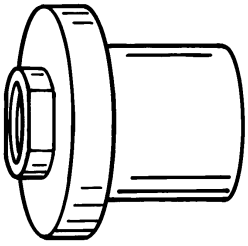
Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

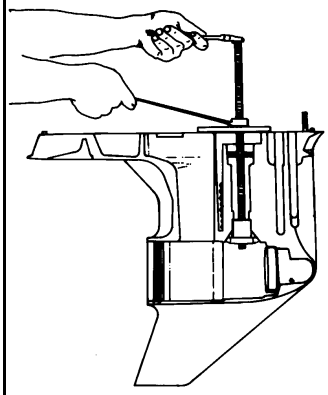
Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

Bearing Driver		
 73462	Installs the drive shaft needle bearings on all the Bravo sterndrive units.	91-89867T

Oil Seal Driver		
 73473	Installs the oil seals in the Bravo One and Bravo Two sterndrive unit bearing carriers.	91-55916

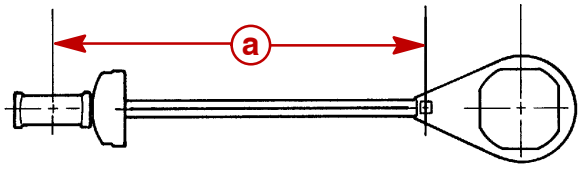
Special Tools (continued)

Bearing Driver		
 73462	Installs the drive shaft needle bearings on all the Bravo sterndrive units.	91-89867T

Bearing Removal and Installation Tool Assembly		
 70615	Installs and removes the bearings on all Alpha and Bravo sterndrive gear cases. 91-31229A7 tool assembly includes the following components: 11-24156 Hex Nut 91-15755T Bearing Carrier 91-29310 Plate 91-29610 Pilot Plate 91-30366T1 Mandrel 91-31229 Puller Shaft 91-32325T Driver Head 91-32336 Driver Needle Bearing 12-34961 Washer 91-36379 Puller / Head Gear 91-36569T Driver Head 91-36571T Pilot Washer 91-37292 Roller Bearing 91-37311 Driver Head 91-37312 Driver Head 91-37323 Driver Head Rod 91-37324 Pilot Washer 91-38628T Puller / Driver Head 91-52393 Driver Needle Bearing 91-52394 Head Pull Rod	91-31229A7

Torque Conversion Chart For Bearing Carrier

Torque Wrench Length		Torque Wrench Reading in lb-ft (Nm) to Achieve 150 lb-ft (203 Nm)	
mm	in.	Nm	lb-ft
381	15	165	122
406	16	167	123
432	17	168	124
457	18	171	126
483	19	172	127
508	20	174	128
533	21	175	129
559	22	175	129
584	23	176	130
610	24	178	131
635	25	179	132
660	26	179	132
686	27	180	133
711	28	180	133
737	29	182	134
762	30	182	134
787	31	183	135
813	32	183	135
838	33	184	136
864	34	184	136
889	35	184	136
914	36	186	137

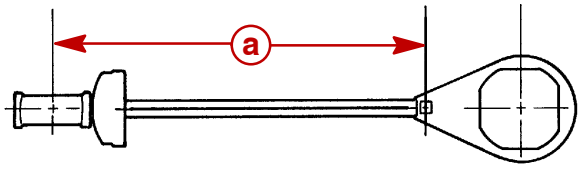


72209

a - Torque wrench length

Torque Conversion Chart For Bearing Retainer Nut

Torque Wrench Length		Torque Wrench Reading in lb-ft (Nm) to Achieve 200 lb-ft (271 Nm)	
mm	in.	Nm	lb-ft
381	15	220	162
406	16	222	164
432	17	225	166
457	18	226	167
483	19	229	169
508	20	230	170
533	21	232	171
559	22	235	173
584	23	236	174
610	24	237	175
635	25	237	175
660	26	239	176
686	27	240	177
711	28	241	178
737	29	241	178
762	30	243	179
787	31	244	180
813	32	244	180
838	33	245	181
864	34	245	181
889	35	247	182
914	36	247	182

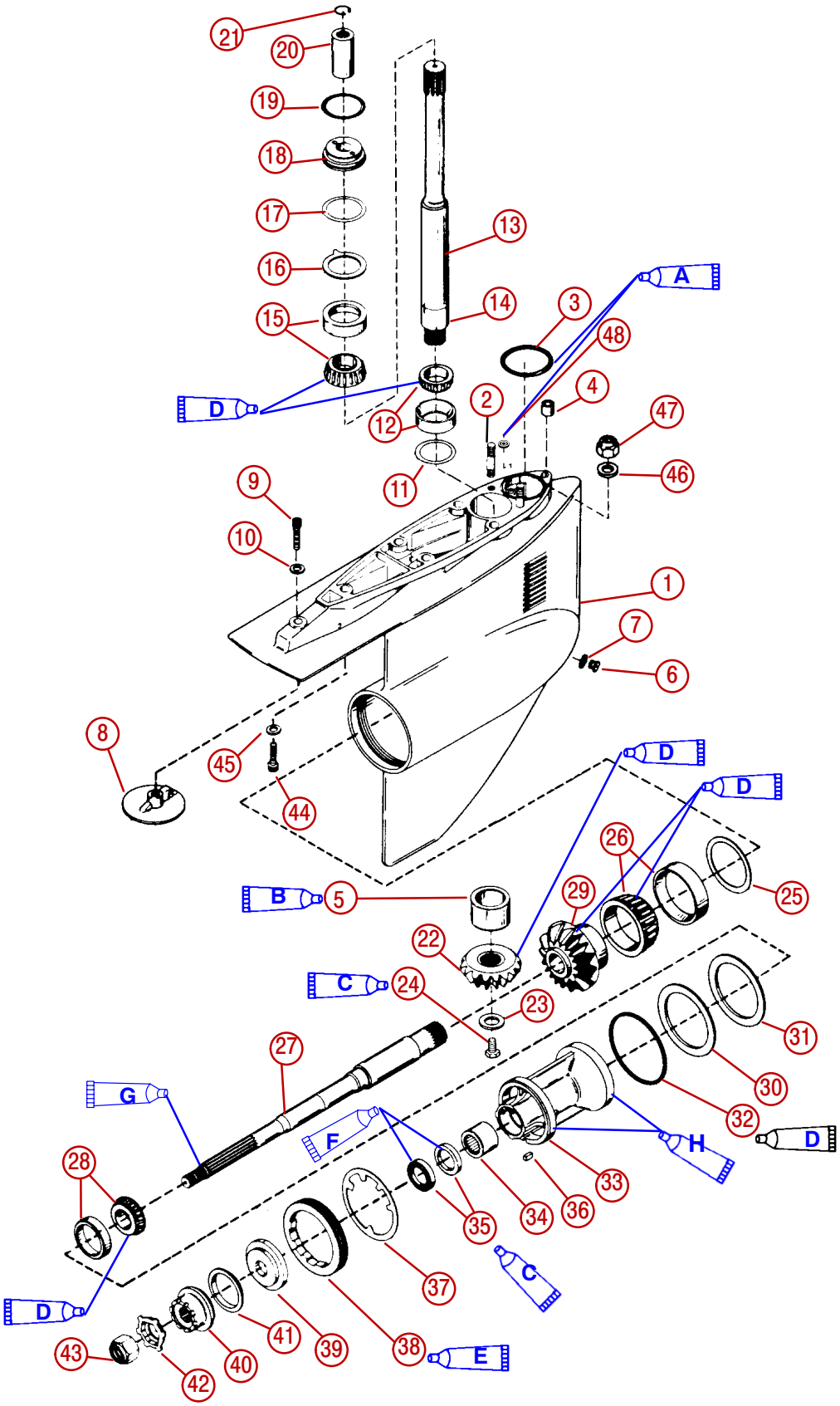


72209

a - Torque wrench length

Bravo Two Gear Housing Exploded View

Drive Shaft and Propeller Shaft Components



7597

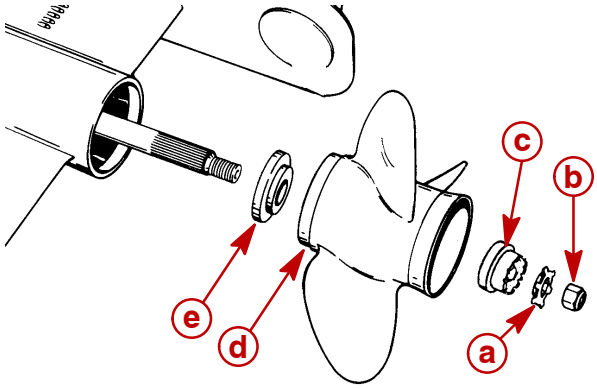
Drive Shaft and Propeller Shaft Components (continued)

1 - Gear housing
2 - Stud
3 - O-ring
4 - Seal
5 - Roller bearing
6 - Fill/drain screw
7 - O-ring
8 - Anodic plate
9 - Screw
10 - Washer
11 - Shim
12 - Tapered roller bearing
13 - Drive shaft
14 - Bearing race
15 - Tapered roller bearing
16 - Tab washer
17 - Shim assembly
18 - Spacer
19 - O-ring
20 - Coupling
21 - Retaining ring
22 - Pinion gear
23 - Washer
24 - Pinion bolt
25 - Shim assembly
26 - Tapered roller bearing
27 - Propeller shaft
28 - Tapered roller bearing
29 - Drive gear
30 - Thrust ring
31 - Load ring
32 - O-ring
33 - Bearing carrier
34 - Roller bearing
35 - Oil seal
36 - Locating key
37 - Tab washer
38 - Bearing carrier retainer
39 - Thrust hub
40 - Washer assembly
41 - Thrust washer
42 - Tab washer
43 - Propeller nut
44 - Screw
45 - Lockwasher
46 - Washer
47 - Nut
48 - Quad ring

Description			Part Number
A	3M Adhesive	Stud	92-86166Q1
		O-ring	
B	Needle Bearing Assembly Lubricant	Roller bearing	92-808868A1
C	Loctite 271 Threadlocker	Oil seals	92-809819
		Nut	
D	High Performance Gear Lube	All bearing surfaces	92-802854A1
		Tapered roller bearing	
		Pinion gear	
		Drive gear	
		O-ring	
E	Special Lubricant 101	Bearing carrier retainer	92-802865A1
		Propeller shaft	
F	2-4-C with Teflon	Oil seals	92-825407A1
G	Perfect Seal	Propeller shaft splines	92-34227-1
H	Anti-Corrosion Grease	Propeller shaft	92-802867A1

Pre-Disassembly Inspection

1. Bend tabs straight on tab washer. Remove nut, washer, spline washer, propeller, and thrust hub.



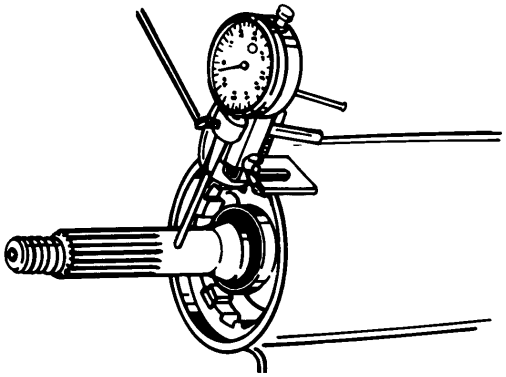
22074

a - Tab washer
b - Nut
c - Spline washer
d - Propeller
e - Thrust hub

2. Check propeller shaft for side to side movement.
   a. Position dial indicator on propeller shaft.
   b. Push propeller shaft to one side and zero the dial indicator.
   c. Move propeller shaft to opposite side while observing dial indicator. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than 0.08 mm (0.003 in.) indicates one of the following:

      (1.) Worn propeller shaft bearings.

      (2.) Improper propeller shaft preload.



76904

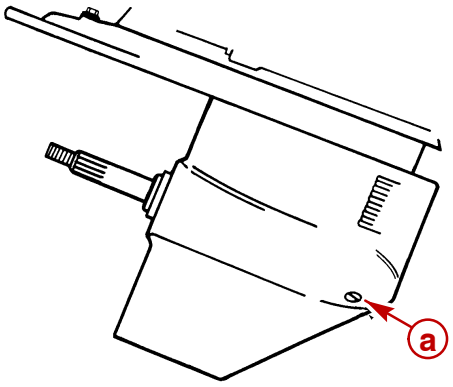
3. Rotate propeller shaft while observing dial indicator. If deflection is more than 0.178 mm (0.007 in.), a bent propeller shaft is indicated.

Drive Shaft Housing and Gear Housing Separation

⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

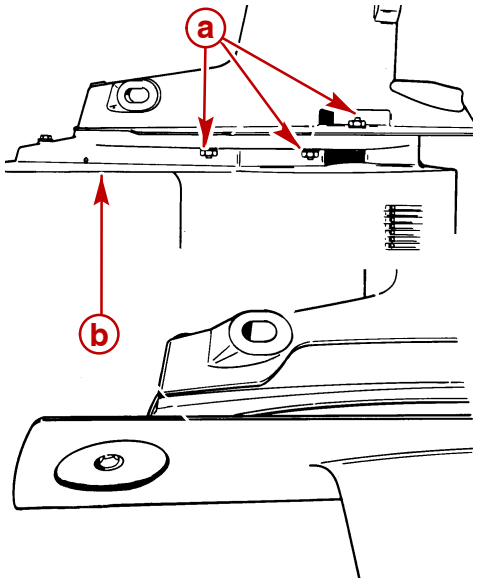
1. Remove, empty, and clean gear lube monitor.
2. Tilt sterndrive unit to a 45 degree angle. Remove fill/drain screw and drive shaft housing vent screw. Allow sterndrive unit to drain completely.



76801

a - Fill/drain screw

3. Remove gear housing from drive shaft housing.



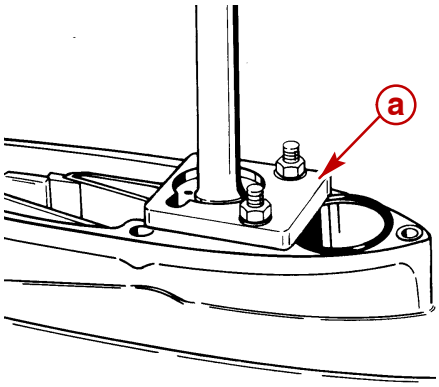
a - Nuts and washers (6)
b - Bolt (1)

Gear Housing Disassembly

⚠ CAUTION

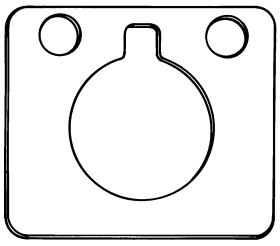
Clamp Plate must be installed on gear housing when gear housing is separated from drive shaft housing.

1. Install clamp plate, nuts, and 4 washers on gear housing. Tighten securely.



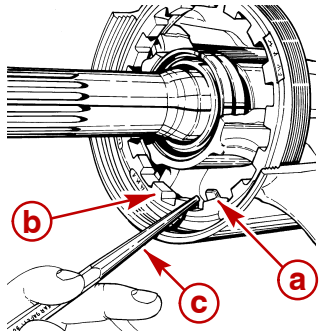
22439

a - Clamp Plate

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

2. Finish draining gear case by turning upside down over a container.

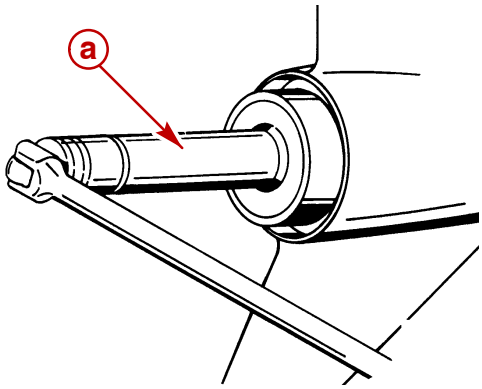
3. Bend tabs of tab washer away from bearing carrier retainer nut.



19830

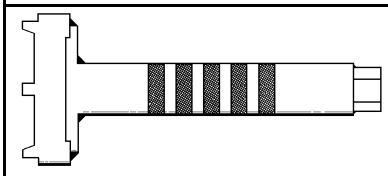
a - Tab washer
b - Bearing carrier retainer nut
c - Punch

4. Remove bearing carrier retainer nut using Bearing Carrier Retainer Tool.

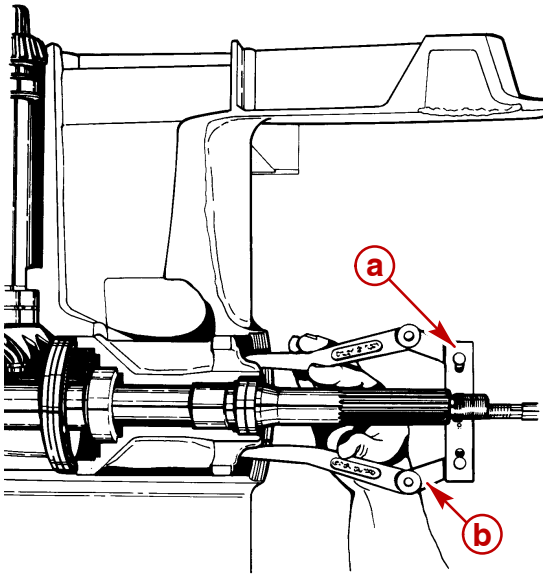


22112

a - Bearing Carrier Retainer Tool

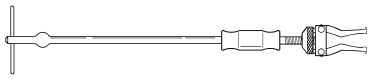
Bearing Carrier Retainer Tool		
 74194	Loosens and tightens the bearing carrier retainer on the Bravo Two sterndrive units.	91-17257

5. Remove bearing carrier using Slide Hammer Puller.



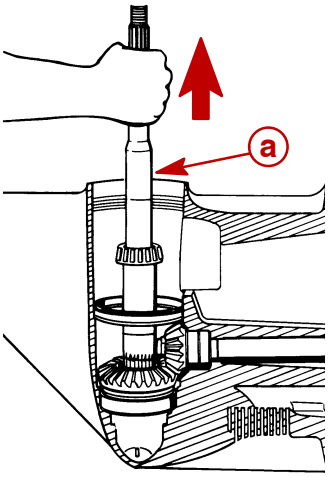
19842

a - Slide Hammer Puller
b - Puller Jaw

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

Description	Part Number
Puller Jaws	91-46086A1

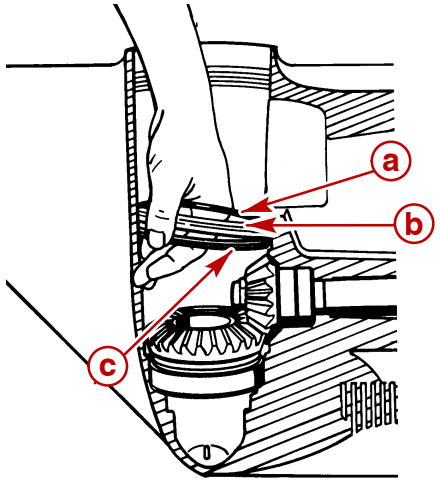
6. Remove propeller shaft assembly.



24211

a - Propeller shaft assembly

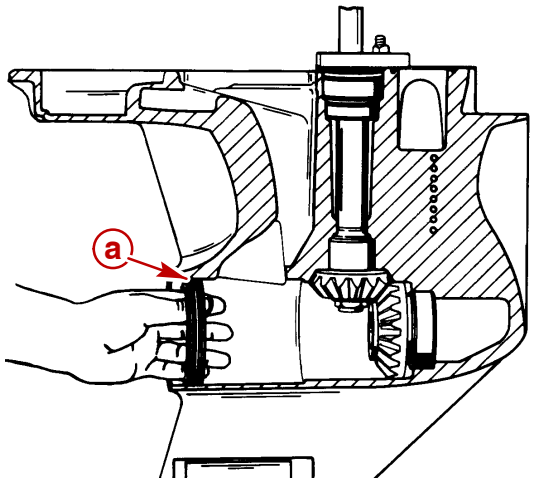
7. Remove o-ring, thrust ring, and load ring.



24211

a - O-ring
b - Thrust ring
c - Load ring

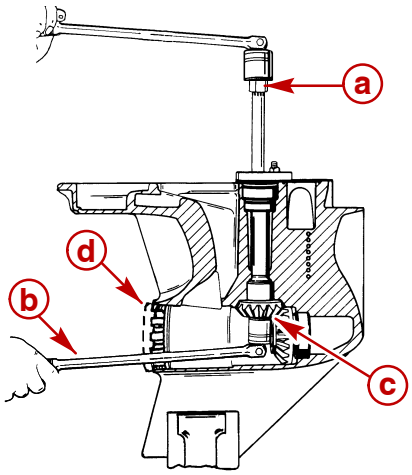
8. Temporarily reinstall retainer nut in gear housing to protect housing threads.



22217

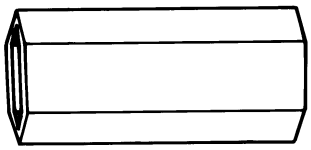
a - Retainer nut

9. Remove pinion gear bolt and washer. Hold drive shaft using Drive Shaft Adapter.



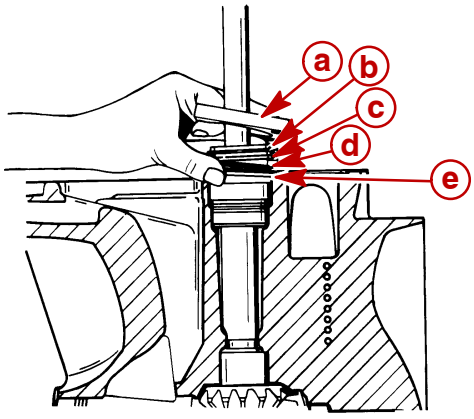
75921

a - Drive Shaft Adapter
b - Breaker bar and socket
c - Pinion gear
d - Bearing carrier retainer

Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo and Blackhawk sterndrive units.	91-61077T

10. Remove Clamp Plate.

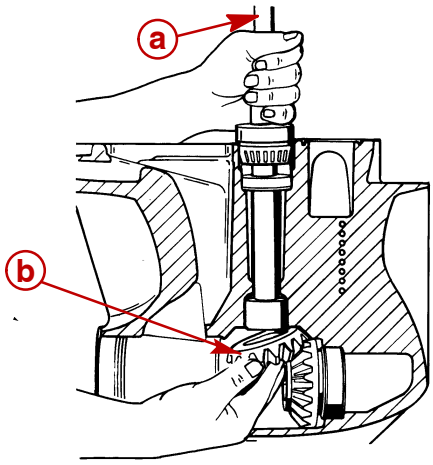
11. Remove O-ring, spacer, shims, and tab washer. Retain shims for reassembly.



22262

a - Drive shaft
b - Pinion gear
c - Spacer
d - Shims
e - Tab washer

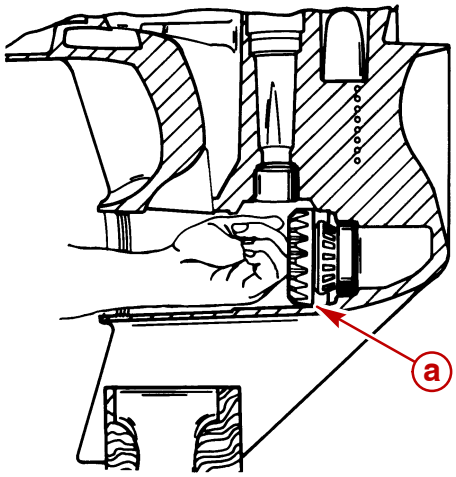
12. Remove drive shaft and pinion gear.



76871

a - Drive shaft
b - Pinion gear

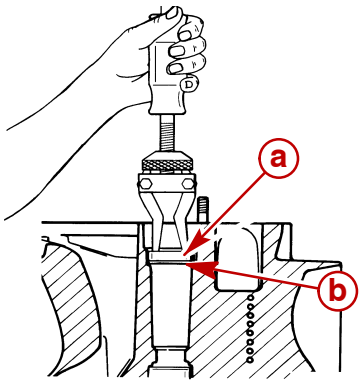
13. Remove driven gear and bearing.



22283

a - Driven gear and bearing

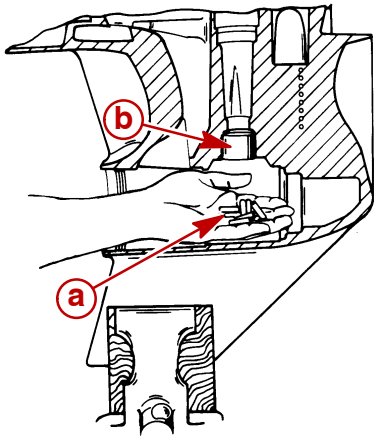
14. Remove drive shaft bearing cup and shims. Retain shims for reassembly.



22261

a - Drive shaft bearing cup
b - Shims

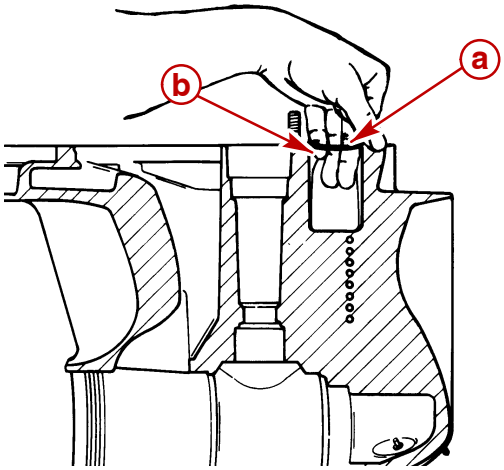
15. Unless you plan to remove the pinion bearing, remove needle bearings from drive shaft needle bearing race. Refer to **Pinion Bearing Removal**.



22083

a - Needle bearings
b - Drive shaft needle bearing race

16. Remove water passage O-ring and oil passage quad ring.



22222

a - Remote water passage O-ring
b - Oil passage quad ring

Drive Shaft and Pinion Bearing

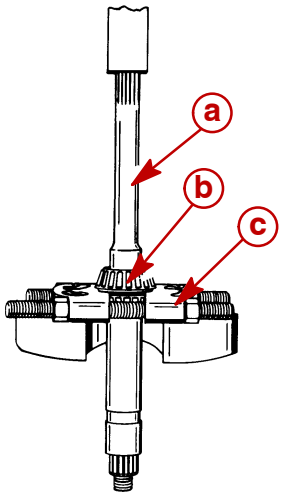
Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replace drive shaft if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

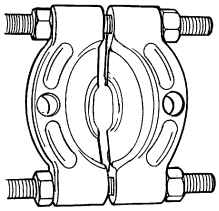
NOTE: *Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removing.*

1. Press tapered roller bearing from shaft using Universal Puller Plate to support bearing on bearing inner race. Remove second tapered roller bearing in same manner.

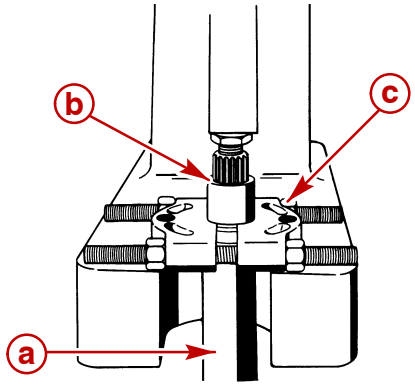


22109

a - Drive shaft
b - Bearing
c - Universal Puller Plate

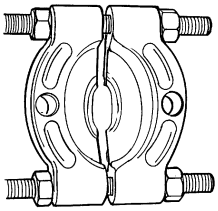
Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

2. Press drive shaft pinion bearing inner race from drive shaft using Universal Puller Plate.



24210

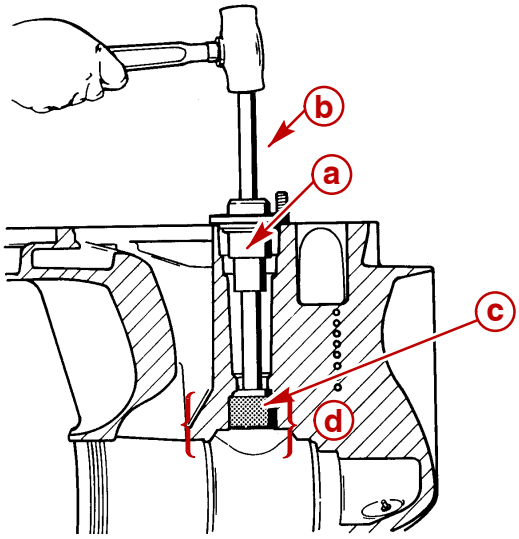
a - Drive shaft
b - Pinion bearing inner race
c - Universal Puller Plate

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Pinion Bearing Removal

IMPORTANT: All needle bearings must be in place inside bearing casing while driving pinion bearing from gear case or bearing casing will bend or break and become difficult to remove.

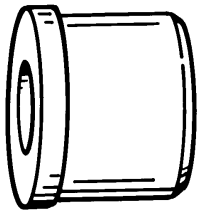
1. Heat area around Bearing Driver to approximately 93 degree C (200 degree F) to ease removal. Do not use open flame. Remove pinion bearing using Bearing Driver and Driver Rod. Use Bearing Driver as a pilot.

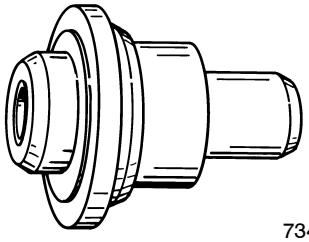


75902

a - Seal Driver
b - Driver Rod
c - Bearing Remover
d - Area around pinion bearing

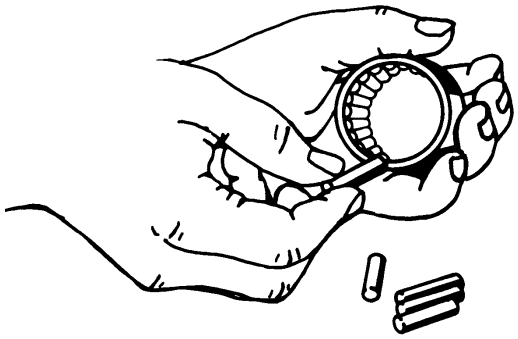
NOTE: *Driver rod 91-37323 is included in the Bearing Removal and Installation Tool Assembly 91-31229A7.*

Bearing Driver		
 73447	Installs and removes the lower drive shaft pinion bearing on the Bravo One, Bravo Two, and Bravo Three sterndrive units.	91-63638T

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

Pinion Bearing Installation

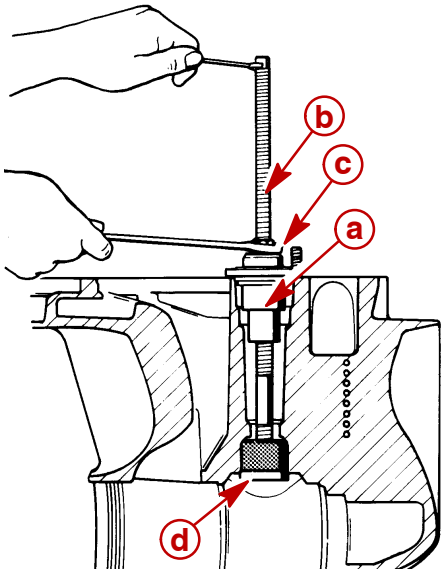
1. Install needles in casing. Use lubricant to help keep needles in place.
2. Position bearing assembly over Bearing Installation Tool with number on bearing casing facing up. Coat outside casing diameter with lubricant.



22219

Description	Where Used	Part Number
Needle Bearing Assembly Lubricant	Needle bearings	92-808868A1
High-Performance Gear Lube	Outside casing diameter	92-802854A1

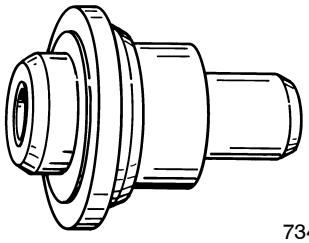
3. Install pinion bearing. Use the Bearing Driver as a pilot.

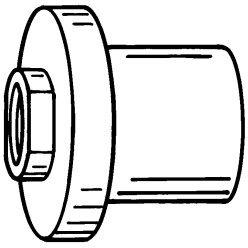


22222

a - Seal Driver
b - Puller shaft
c - Washer and nut
d - Bearing Driver

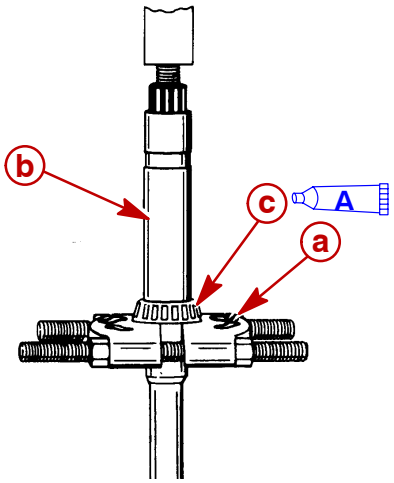
NOTE: *Puller Shaft 91-31229 is included in the Bearing Removal and Installation Tool Assembly 91-31229A7.*

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

Bearing Driver		
 73462	Installs the drive shaft needle bearings on all the Bravo sterndrive units.	91-89867T

Drive Shaft Reassembly

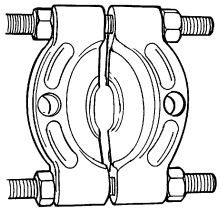
1. Lubricate inside diameter of tapered roller bearing.
2. Press small tapered roller bearing onto drive shaft using Universal Puller Plate.
3. Ensure that smaller outside diameter faces pinion end of shaft.



22109

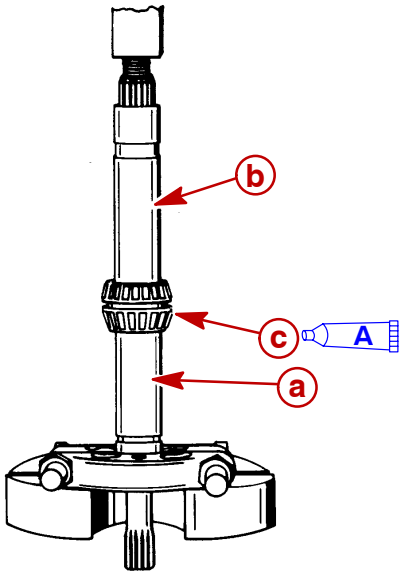
a - Universal puller plate
b - Drive shaft
c - Small tapered roller bearing

Description		Where Used	Part Number
A	High Performance Gear Lube	Inside diameter of tapered roller bearing	92-802854A1

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

4. Lubricate inside diameter of tapered roller bearing.
5. Press large tapered roller bearing onto drive shaft using suitable mandrel or old bearing race.

6. Ensure that larger outside diameter faces pinion end of shaft.

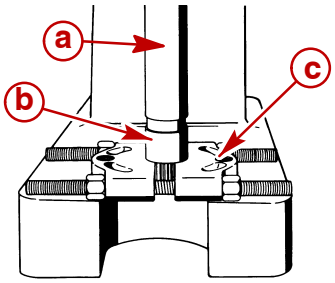


22109

a - Suitable mandrel (on inner race of bearing)
b - Drive shaft
c - Large tapered roller bearing

Description		Where Used	Part Number
A	High Performance Gear Lube	Inside diameter of tapered roller bearing	92-802854A1

7. Press drive shaft pinion bearing inner race onto drive shaft until race is fully seated using Universal Puller Plate.



24210

a - Drive shaft
b - Pinion bearing inner race
c - Universal Puller Plate

Bearing Carrier

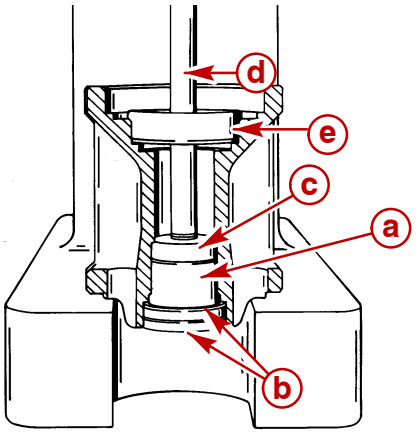
Inspection

1. The condition of the propeller shaft tapered roller bearing cup is an indication of the condition of tapered roller bearing on propeller shaft. Replace bearing and cup if cup is pitted, grooved, scored, worn, uneven, discolored from overheating, or has embedded metal particles.
2. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.

Disassembly

1. Perform Method “A or B,” following:
   a. **Method A:** If replacing propeller shaft needle bearing:
      (1.) Press needle bearing and oil seals from carrier.

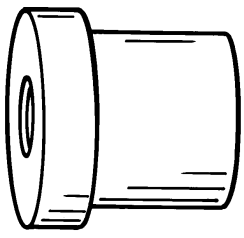
NOTE: *Needle bearing must be replaced if removed.*



50023

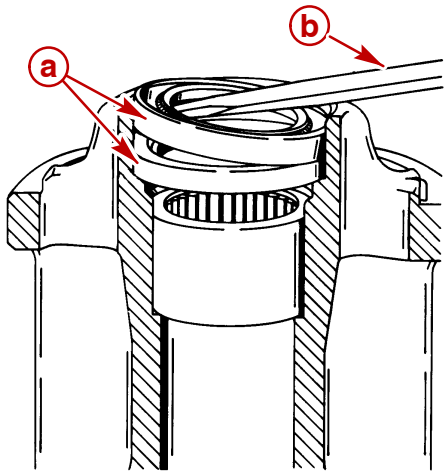
a - Needle bearing
b - Oil seals (2)
c - Bearing Driver
d - Driver rod
e - Bearing cup

NOTE: *Driver rod 91-37323 is included in the Bearing Removal and Installation Tool Assembly 91-31229A.*

Bearing Driver		
 73466	Installs the needle bearings in the Bravo One, Bravo Two, and Bravo Three sterndrive unit bearing carriers.	91-55918

b. **Method B:** If propeller shaft needle bearing replacement is not required:

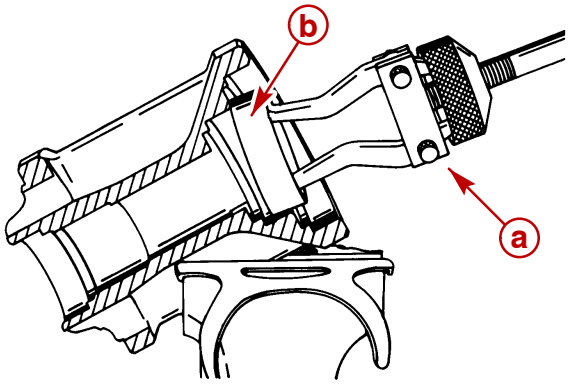
(1.) Pry oil seals from carrier.



50024

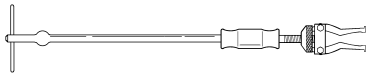
a - Oil seals (2)
b - Pry bar or screwdriver

2. Remove bearing cup using Slide Hammer Puller.



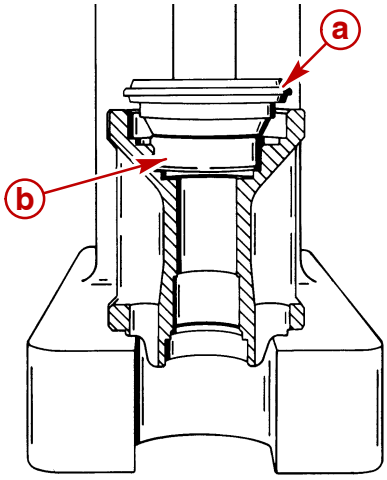
50025

a - Slide Hammer Puller
b - Bearing cup

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

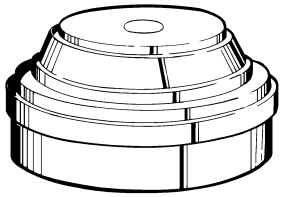
Reassembly

1. Install bearing cup using Bearing Cup Driver.

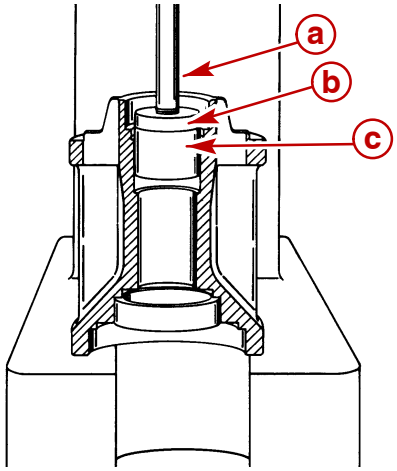


50023

a - Bearing Cup Driver
b - Bearing Cup

Bearing Cup Driver		
 73646	Installs the bearing cup in the Bravo Two bearing carriers.	91-63626

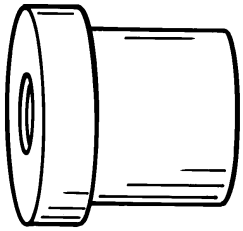
2. Install needle bearing using Bearing Driver and Driver Rod.



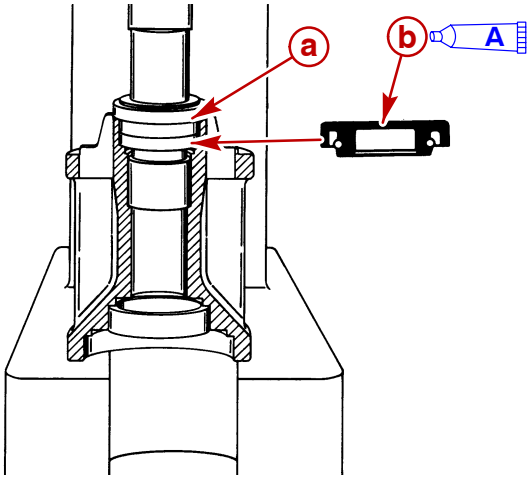
50025

a - Driver Rod
b - Bearing Driver
c - Needle bearing

NOTE: *Driver Rod 91-37323 is included in the Bearing Removal and Installation Tool Assembly 91-31229A7.*

Bearing Driver		
 73466	Installs the needle bearings in the Bravo One, Bravo Two, and Bravo Three sterndrive unit bearing carriers.	91-55918

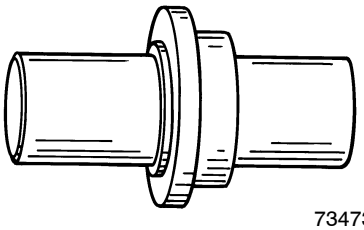
3. Coat outside diameter of oil seal with threadlocker.
4. Install inner oil seal with lip facing inward using Oil Seal Driver.



50024

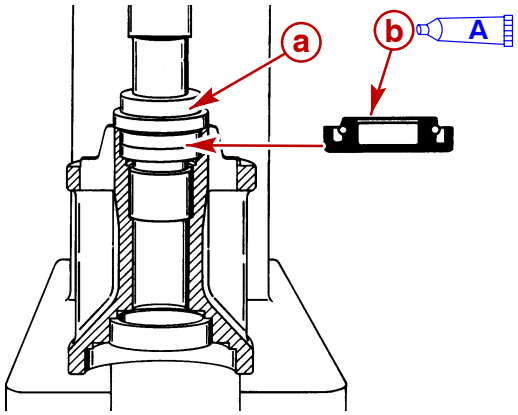
a - Oil Seal Driver
b - Inner oil seal

Description		Where Used	Part Number
A	Loctite 271	Outside diameter of oil seal	92-809819

Oil Seal Driver		
 73473	Installs the oil seals in the Bravo One and Bravo Two sterndrive unit bearing carriers.	91-55916

5. Coat outside diameter of oil seal with threadlocker.

6. Install outer oil seal with lip facing outward using Oil Seal Driver.



50025

a - Oil Seal Driver
b - Outer oil seal

Description		Where Used	Part Number
A	Loctite 271	Outside diameter of oil seal	92-809819

7. Fill area between seals with lubricant.

Description	Where Used	Part Number
2-4-C with Teflon	Area between seals	92-802859A1

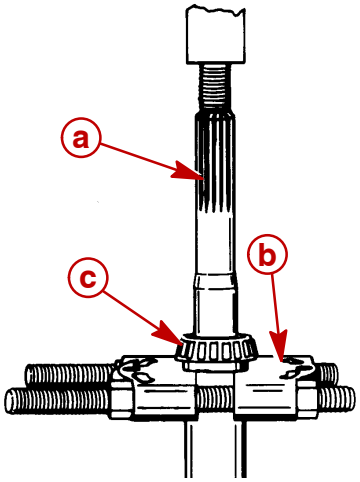
Propeller Shaft

Inspection

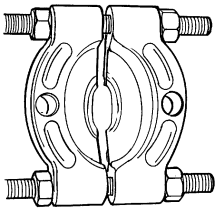
1. **Method A: Lathe And Dial Indicator Method:**
   a. Position propeller shaft centers in lathe.
   b. Mount dial indicator at front edge of propeller shaft.
   c. Rotate shaft and observe dial indicator. Movement of more than 0.179 mm (0.007 in.) indicates a bent propeller shaft and is reason for replacement.
2. **Method B: V-blocks And Dial Indicator Method:**
   a. Position propeller shaft bearing surfaces on V-blocks.
   b. Mount a dial indicator at front edge of propeller shaft.
   c. Rotate shaft and observe dial indicator. Movement of more than 0.179 mm (0.007 in.) indicates a bent propeller shaft and is reason for replacement.
3. Inspect for bent or twisted splines.
4. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Oil seals will have to be replaced if any grooves are found.

Propeller Shaft Bearing Removal

1. Press bearing from shaft using Universal Puller Plate.

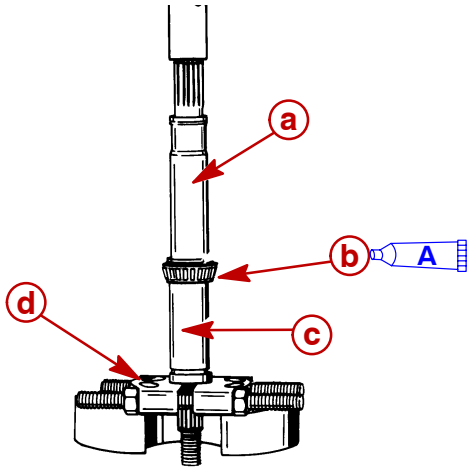


a - Propeller shaft
b - Universal Puller Plate
c - Tapered roller bearing

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Propeller Shaft Bearing Installation

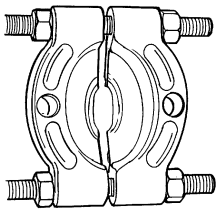
1. Apply lubricant to inside diameter of new bearing.
2. Install bearing to shaft using Universal Puller Plate and a suitable mandrel (old bearing race) which supports bearing on inner race. Press into place.



22110

a - Propeller shaft
b - Tapered roller bearing
c - Suitable mandrel
d - Universal Puller Plate

Description		Where Used	Part Number
A	High Performance Gear Lube	Tapered roller bearing	92-802854A1

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

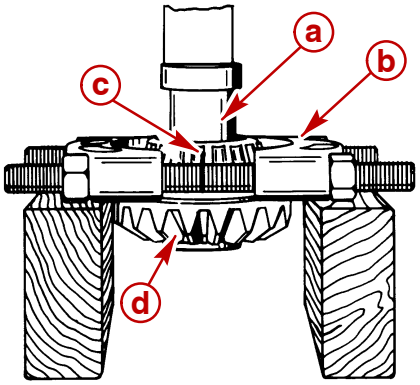
Driven Gear Bearing

Inspection

1. Remove bearing from driven gear. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth, and excessive or uneven wear. Replace both gears if any of these conditions exist.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scoured, worn uneven, discolored from overheating, or has metal particles embedded in the cup.

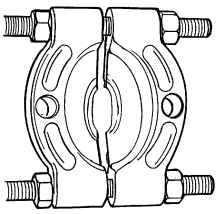
Driven Gear Bearing Removal

1. Remove bearing from driven gear using Universal Puller Plate.
2. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth, and excessive or uneven wear. Replace both gears if any of these conditions exist.



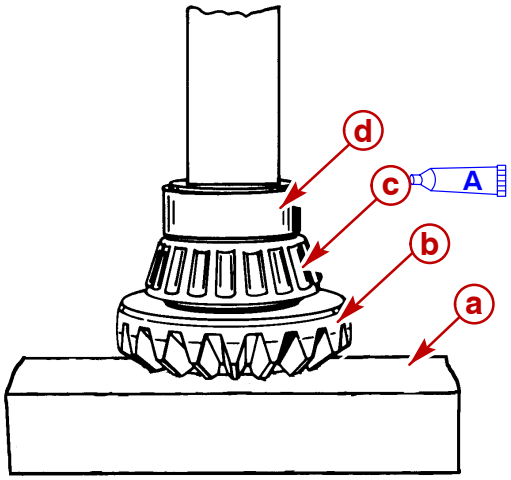
22108

a - Suitable mandrel
b - Universal Puller Plate
c - Bearing
d - Driven gear

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Driven Gear Bearing Installation

1. Apply lubricant to inside diameter of new bearing.
2. Place a suitable mandrel (old bearing race) against new bearing race. Place another mandrel on face of gear and press gear and bearing together.



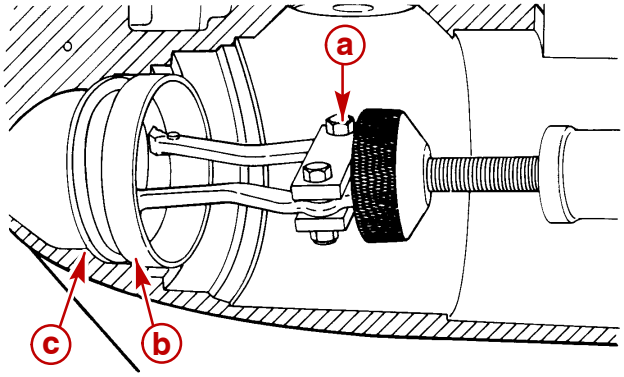
22108

a - Metal block
b - Driven gear
c - Tapered roller bearing
d - Mandrel - contacting inner race

Description		Where Used	Part Number
A	High Performance Gear Lube	Tapered roller bearing	92-802854A1

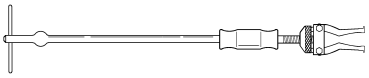
Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims using Slide Hammer Puller.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has metal particles embedded in the cup.



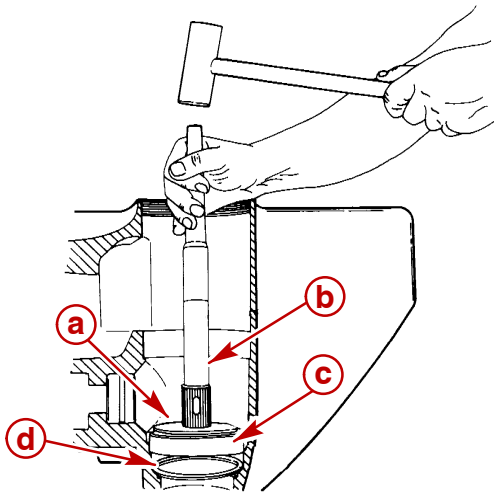
19808

a - Slide Hammer Puller
b - Bearing cup
c - Shims

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

Driven Gear Bearing Cup Installation

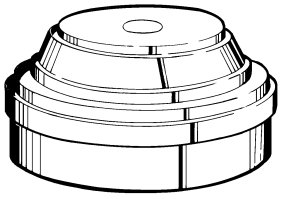
1. Ensure that cup is not canted.
2. Coat cup outside diameter with lubricant.
3. Install driven gear bearing cup with original thickness shims using Bearing Cup Driver.



19917

a - Bearing Cup Driver
b - Old MC-I propeller shaft
c - Bearing cup
d - Shims

Description	Where Used	Part Number
High Performance Gear Lube	All bearing surfaces	92-802854A1

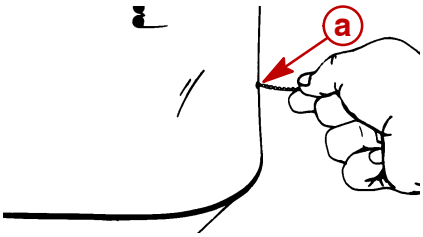
Bearing Cup Driver		
 73646	Installs the bearing cup in the Bravo Two bearing carriers.	91-63626

NOTE: *If a MC-I propeller shaft is not available, use Driver Rod 91-37323 from Bearing Removal and Installation Kit, 91-31229A7.*

Speedometer Water Passage

Pickup Inspection and Cleaning

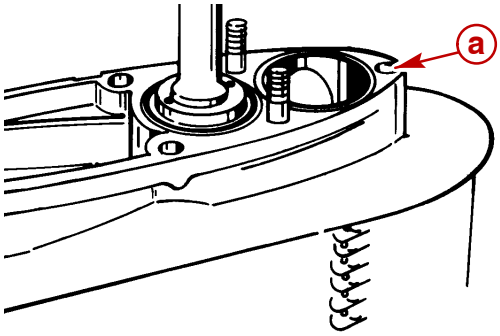
1. Inspect pitot tube on leading edge of gear housing for obstruction.
2. Clean opening with a short piece of wire. If obstruction can not be removed with wire, carefully re-open tube using a 2 mm (5/64 in.) diameter drill bit. Do not drill beyond a depth of 62 mm (2-7/16 in.).



22462

a - Pitot tube

3. Inspect water passage seal for nicks, cuts, or distortion. Replace if necessary.

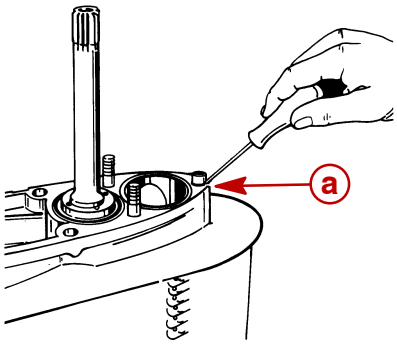


22085

a - Speedometer water passage seal

Water Passage Seal Replacement

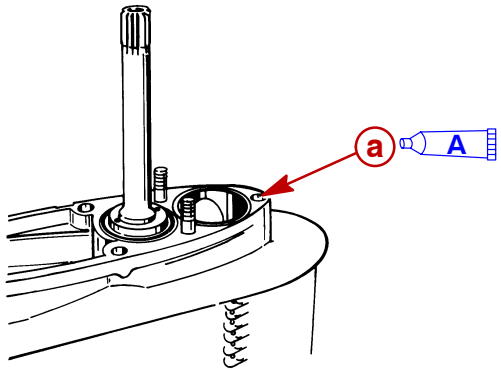
1. Pry rubber seal out with a suitable tool.



22085

a - Rubber seal

2. Lightly coat outside diameter of seal with adhesive.
3. Install in speedometer water passage bore. Ensure that top edge of seal is flush with gear housing surface.



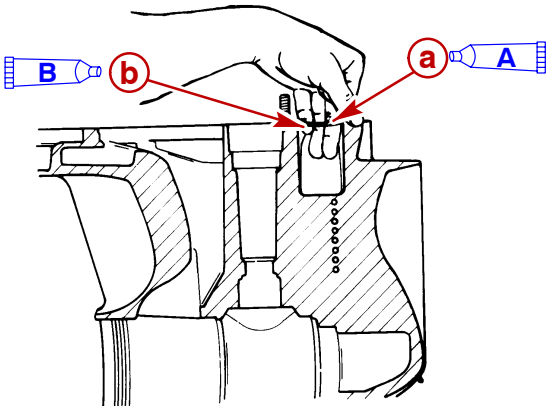
22085

a - Seal

Description		Where Used	Part Number
A	Bellows Adhesive	Outer diameter of seal	92-86166Q1

Gear Housing Reassembly and Shimming

1. Lubricate all gears and bearings before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using adhesive.

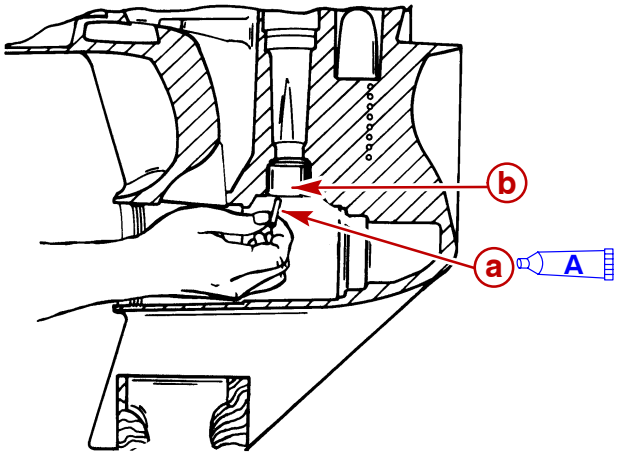


22222

a - Water passage O-ring
b - Oil passage quad ring

Description		Where Used	Part Number
A	Bellows Adhesive	Water passage O-ring and oil passage quad ring	92-86166Q1
B	High Performance Gear Lube	All bearings	92-802854A1

3. Install needle bearings into lower needle bearing casing. Use lubricant to hold needle bearings in place.

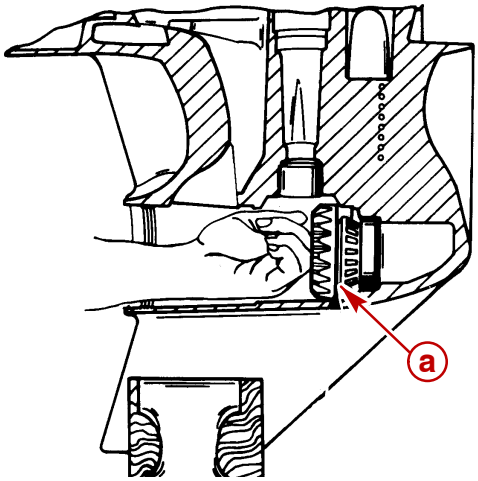


22083

a - Needle bearings
b - Needle bearing casing

Description		Where Used	Part Number
A	Needle Bearing Assembly Lubricant	Needle bearings	92-802868A1

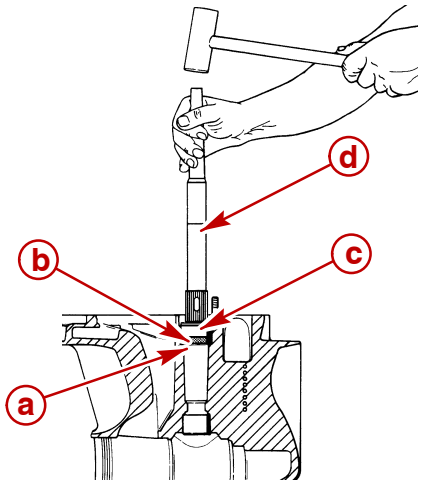
4. Install driven gear assembly.



22083

a - Driven gear assembly

5. Install original thickness shims and drive shaft lower bearing cup using Bearing Driver and old drive shaft. Use original shims or, if lost or misplaced, start with 0.050 in. (1.27 mm).



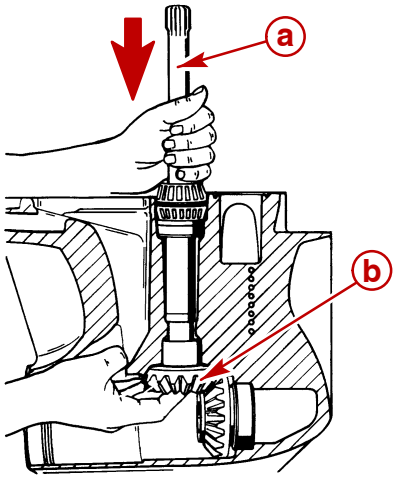
75903

.

a - Shims
b - Lower bearing cup
c - Bearing Driver
d - Old propeller shaft

Description	Part Number
Bearing Driver	91-636387

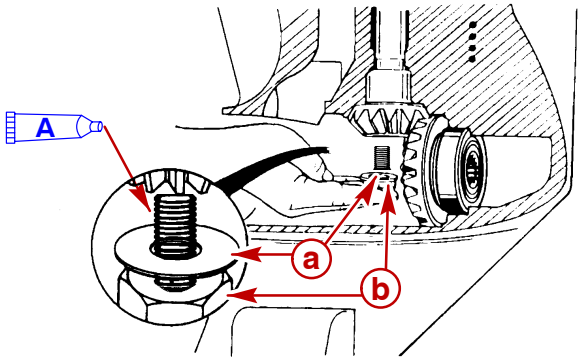
6. Install drive shaft and pinion gear.



22258

a - Drive shaft
b - Pinion gear

7. Install washer and new pinion bolt. Apply threadlocker to threads of nut.

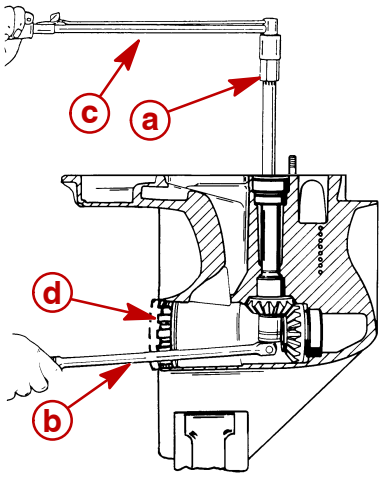


76877

a - Washer
b - Pinion bolt

Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Threads of pinion bolt	92-809819

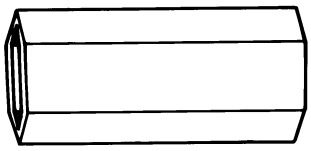
8. Temporarily install bearing carrier retainer nut to avoid damage to threads.
9. Torque pinion bolt.



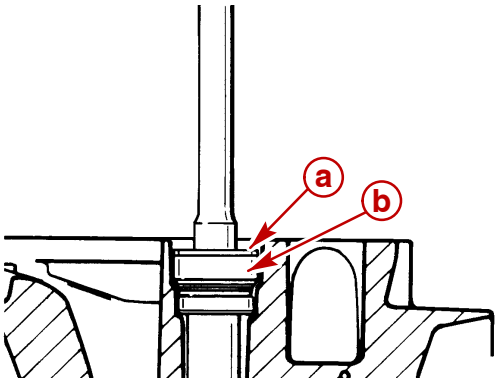
75921

a - Drive Shaft Adapter
b - Breaker bar and socket
c - Torque wrench and socket
d - Bearing carrier retainer nut

Description	Nm	lb-in.	lb-ft
Pinion bolt	136		100

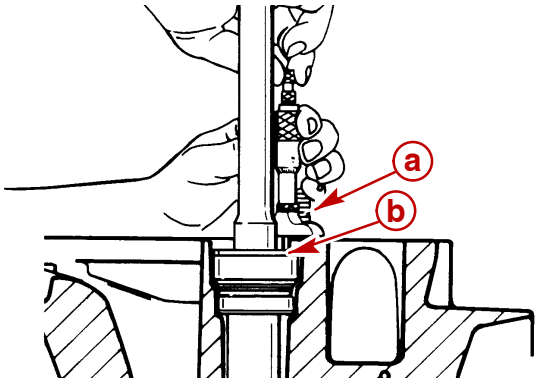
Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo and Blackhawk sterndrive units.	91-61077T

10. Remove bearing carrier retainer nut previously placed in unit for protection of threads.
11. Install upper bearing cup and tab washer.



a - Tab washer
b - Upper bearing cup

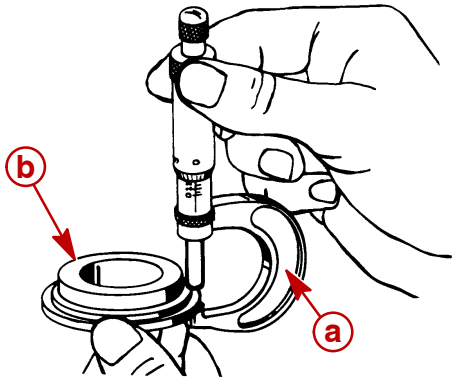
12. Determine shim thickness required for drive shaft bearing preload using the following procedure or use original thickness shims.
    a. Measure distance between top of gear housing and tab washer using a 0-25 mm (0-1 in.) depth micrometer.



22259

a - Depth micrometer
b - Tab washer

    b. Measure thickness of spacer from top machined surface to bottom machined surface.



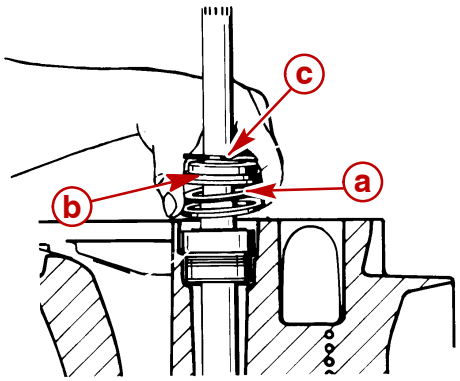
22112

a - Outside micrometer
b - Spacer

c. Calculate shim thickness as shown.

Measurement from Step “a”
–(Measurement from Step “b” + 0.025 mm [0.001 in.])
Shim Thickness Required.

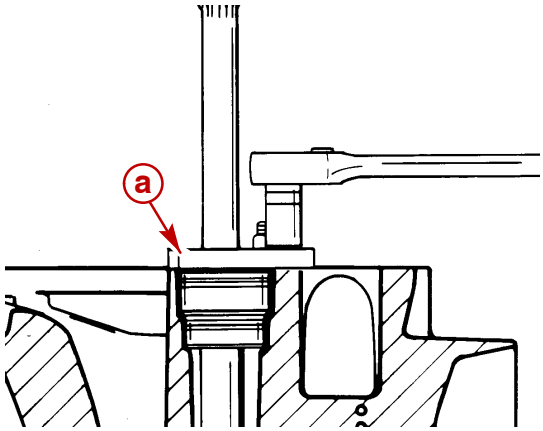
13. Install shims, spacer, and O-ring.



22259

a - Shims
b - Spacer
c - O-Ring

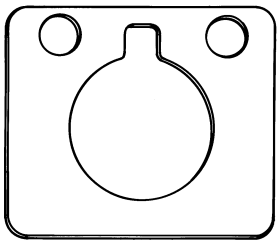
14. Install Clamp Plate on gear housing with 4 nuts and washers and torque.



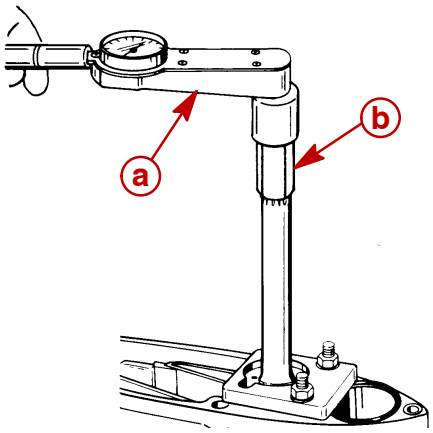
22262

a - Clamp Plate

Description	Nm	lb-in.	lb-ft
Clamp Plate	47		35

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

15. Using a dial-type lb-in. torque wrench, check the rolling preload by turning drive shaft with a slow steady motion.



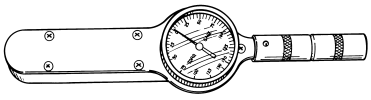
50410

a - Torque wrench
b - Drive Shaft Adapter

Description	Part Number
Drive Shaft Adapter	91-61077T

16. If preload is incorrect, adjust by adding or subtracting shims from upper tapered roller bearing cup.
17. Reinstall clamp plate and recheck preload.
18. Record final preload.

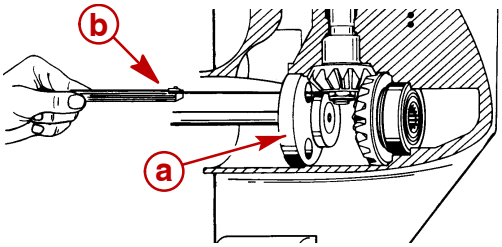
Description	Nm	lb-in.	lb-ft
Rolling preload of drive shaft	0.3-0.6	3-5	

Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

19. Check pinion height.

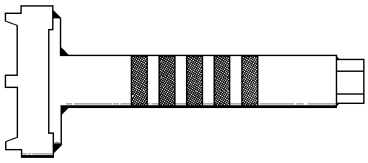
    a. Rotate drive shaft several times to seat bearings. Insert Shimming Tool into gear housing.

    b. Measure clearance between tool and pinion gear using feeler gauge and Shimming Tool. Take measurement at 3 locations on pinion gear (120 degrees apart).



50370

a - Gear Case Shimming Tool
b - Feeler gauge

Bearing Carrier Retainer Tool		
 74194	Loosens and tightens the bearing carrier retainer on the Bravo Two sterndrive units.	91-17257

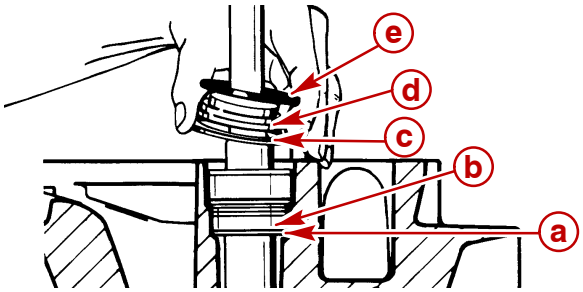
Description	
Pinion gear clearance	0.635 mm (0.025 in.)

c. If clearance is less than specified: Add appropriate thickness of shims under lower tapered roller bearing cup.

Any thickness added here must be subtracted from shim thickness at upper bearing.

If clearance is more than specified, remove appropriate thickness of shims from under lower tapered roller bearing cup.

Any thickness subtracted here must be added to shim thickness at upper bearing.

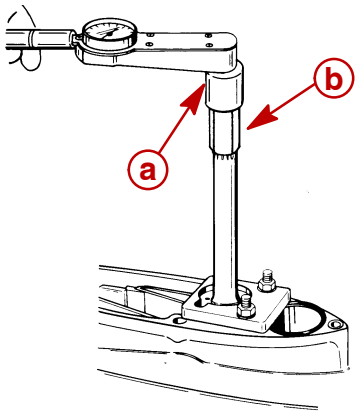


22262

a - Lower shims
b - Lower bearing cup
c - Upper shims
d - Spacer
e - O-Ring

d. Recheck clearance after changing shims.

20. Using a dial-type lb-in. torque wrench, recheck the rolling preload by rotating drive shaft with a slow steady motion.



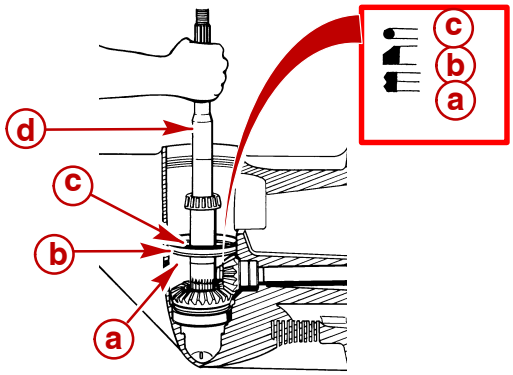
50410

a - Torque wrench
b - Drive Shaft Adapter

Description	Nm	lb-in.	lb-ft
Rolling preload of drive shaft	0.3-0.6	3-5	

Description	Part Number
Drive Shaft Adapter	91-61077T

21. Install the propeller shaft, original load ring, thrust ring, and O-ring into the gear housing.

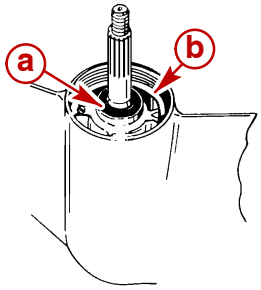


76883

a - Load ring
b - Thrust ring
c - O-ring
d - Propeller shaft

22. Install bearing carrier and tab washer.

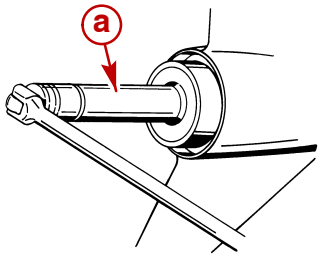
23. Align inner tab of tab washer with V-notch in bearing retainer and outer tab with hole in gear housing.



79262

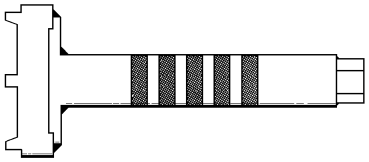
a - Bearing carrier
b - Tab washer

24. Install and tighten bearing carrier retaining nut using Retainer Tool until resistance to propeller shaft rotation can be felt (to preload bearings).

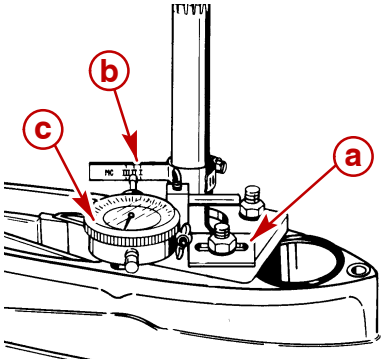


22112

a - Bearing Carrier Retainer Tool

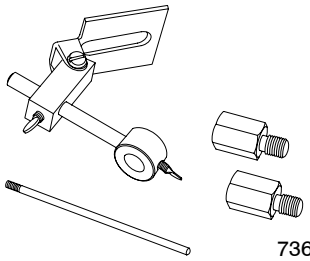
Bearing Carrier Retainer Tool		
 74194	Loosens and tightens the bearing carrier retainer on the Bravo Two sterndrive units.	91-17257

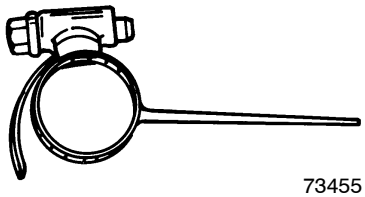
25. To shim driven gear, install Dial Indicator Adapter, Backlash Indicator Rod, and Dial Indicator. Ensure that dial rod is aligned with “II” on Indicator Rod.

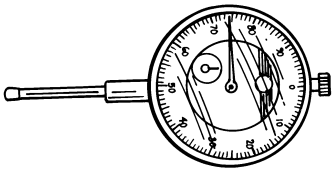


22439

a - Dial Indicator Adapter
b - Backlash Indicator Rod
c - Dial Indicator

Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-83155

Backlash Indicator Rod		
 73455	Checks the gear backlash on the Bravo One and Bravo Two sterndrive units.	91-53459

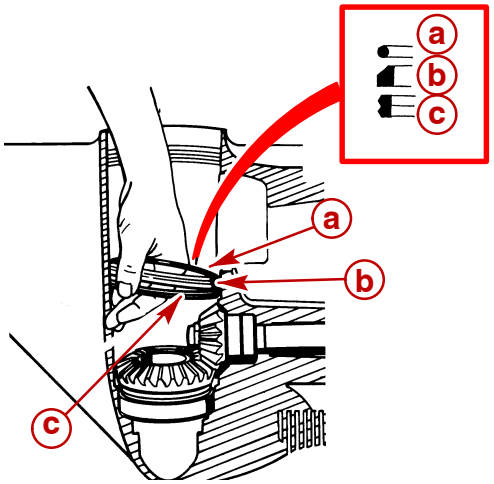
Dial Indicator		
 73429	Measures the gear backlash on all the Alpha and Bravo sterndrive units.	91-58222A1

26. Check gear backlash by lightly rotating drive shaft back and forth. Do not allow propeller shaft to turn. Observe dial indicator.

Description	**mm (in.)**
Gear backlash	0.28-0.38 mm (0.009-0.015 in.)

27. If backlash is not correct, disassemble and proceed as follows:
    a. If backlash is more than specified, add shims under driven gear bearing cup.
    b. If backlash is less than specified, remove shims under driven gear bearing cup.
    c. Recheck backlash reading after reassembly.
28. Remove bearing carrier, propeller shaft, and items shown. Reinstall the propeller shaft and items shown using new load ring.

IMPORTANT: Always use a new load ring when reassembling.

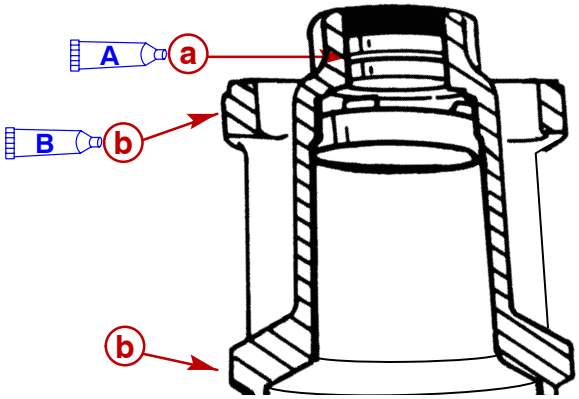


76884

a - O-ring
b - Thrust ring
c - Load ring

IMPORTANT: Bearing carrier and threads on retainer must be lubricated to prevent corrosion and cracking in gear housing. Use lubricant on retainer and coat outside diameter on carrier rounds with sealant.

29. Lubricate bearing carrier seals and coat carrier mating surfaces with sealant.

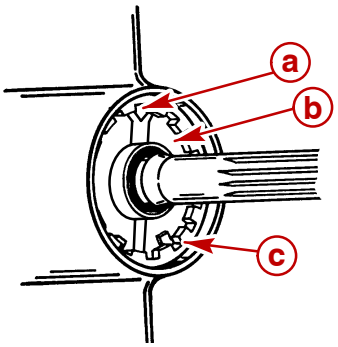


a - Space between seals
b - Carrier mating surfaces

Description		Where Used	Part Number
A	2-4-C with Teflon	Bearing carrier seals and spaces between seals	92-802859A1
B	Perfect Seal	Carrier mating surfaces	92-34227-1

30. Install bearing carrier and tab washer in gear housing.

31. Lubricate threads on bearing carrier retaining nut. Install and tighten bearing carrier retainer nut until resistance to propeller shaft rotation can be felt (to preload bearings).



a - Tab washer - V-notch in recess in carrier
b - Bearing carrier
c - Bearing carrier retainer nut

Description	Where Used	Part Number
Special Lubricant 101	Threads on bearing carrier retaining nut	92-802865A1

32. To determine overall gear case preload, add drive shaft bearing preload (previously recorded) to propeller shaft bearing preload as outlined in the example below.

IMPORTANT: The overall preload includes both the drive shaft preload and the gear case preload.

Description	Nm	lb-in.
Rolling Preload of Drive Shaft bearing	0.3-0.6	3-5
Overall Preload Checked at Inner Propeller Shaft (New Bearings)	0.9-1.14[1]	8-12[1]
Overall Gear Case Preload Checked at Inner Propeller Shaft (Used Bearings)[2]	0.6-0.9[1]	5-8[1]

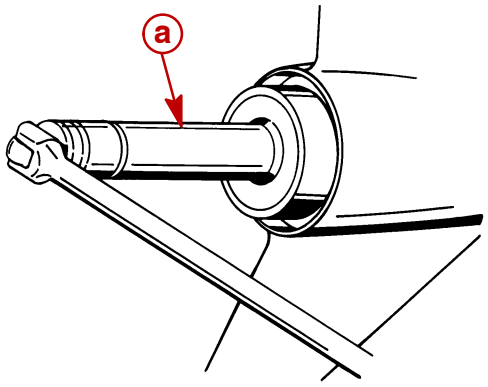
[1] *Bearing is considered used if spun under load even once ("under load" meaning: with power applied).*

[2] *Plus drive shaft preload of 0.3-0.6 Nm (3-5 lb-in.)*

Example:

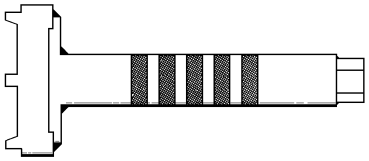
Drive Shaft Preload	0.3 Nm (3 lb-in.)
	+
New Bearing Preload	0.9 Nm (8 lb-in.)
	1.2 Nm (11 lb-in.)

33. Tighten retainer in small increments using Bearing Carrier Retainer Tool.

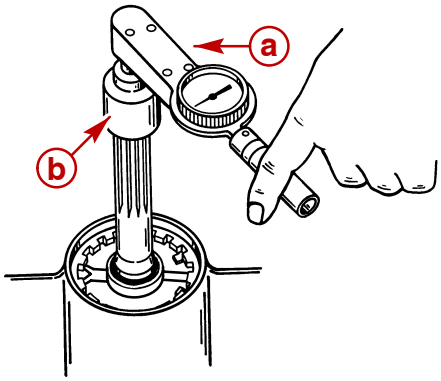


22112

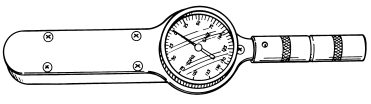
a - Bearing Carrier Retainer Tool

Bearing Carrier Retainer Tool		
 74194	Loosens and tightens the bearing carrier retainer on the Bravo Two sterndrive units.	91-17257

34. Using an lb-in. torque wrench, check overall gear housing bearing preload by rotating propeller shaft in direction of normal rotation with a slow steady motion.

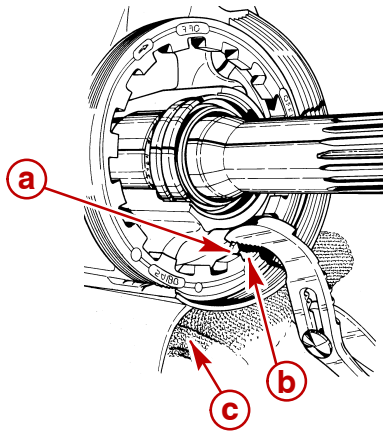


a - Torque wrench
b - Propeller nut (under socket)

Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

35. Continue tightening bearing carrier retainer nut and checking preload until specified bearing preload is attained.

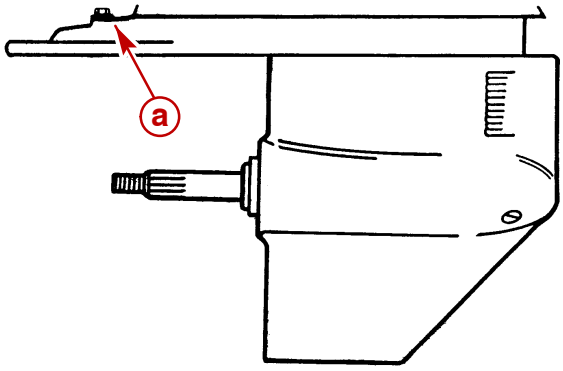
36. Bend one tab into retaining nut after propeller shaft preload has been set correctly.
37. Bend remaining tabs down into gear housing. Cushion housing to avoid chipping or scratching paint.



19831

a - Tab washer tab
b - Groove in retainer
c - Cushioning

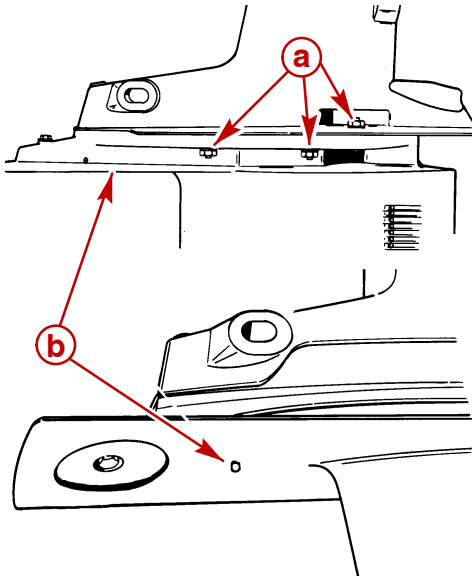
38. Install anodic plate and torque screw.



a - Screw

Description	Nm	lb-in.	lb-ft
Anodic plate screw	27		20

39. Install gear housing to drive shaft housing. Torque fasteners.



a - Nuts and washers (3 each side)
b - Bolt (1)

Description	Nm	lb-in.	lb-ft
Gear housing to drive shaft housing fasteners	47		35

40. Reinstall sterndrive unit. Refer to **Section 2A - Removal, Installation, and Adjustments**.
41. Reinstall fill/drain plug.
42. Fill sterndrive unit Refer to **Section 1B - Maintenance**.

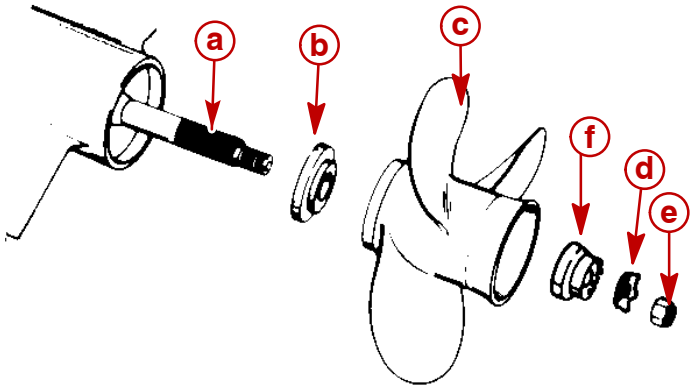
Propeller Installation

IMPORTANT: Correct rotation propeller must match direction of rotation of propeller shaft.

1. Install propeller.
2. Apply lubricant on splines of propeller shaft.

Description	Where Used	Part Number
Special Lubricant 101	Propeller shaft	92-802865A1
2-4-C with Teflon		92-802859A1
Anti-Corrosion Grease		92-802867A1

3. Torque the nut, then continue to tighten until 3 tabs on the tab washer align with grooves on spline washer. Bend the 3 tabs down into grooves.



70561

a - Propeller shaft splines
b - Forward thrust hub
c - Propeller
d - Tab washer
e - Locknut
f - Spline washer

Description	Nm	lb-in.	lb-ft
Locknut	75		55
	Then align tabs with grooves.		

NOTES:

STERNDRIVE UNIT

Section 3D - Bravo Three Gear Housing

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3 D

Specifications

Bearing Preloads

Description	Nm	lb-in.
Drive Shaft Bearing	0.3-0.6	3-5
Overall Preload Checked at Inner Propeller Shaft (New Bearings)	0.9-2[1]	8-18[1]
Overall Gear Case Preload Checked at Inner Propeller Shaft (Used Bearings)[2]	0.6-1.7[1]	5-15[1]

[1] *Includes drive shaft preload.*

[2] *A bearing is used if spun once under load.*

Gear Backlash

Description	mm	in.
Gear backlash	0.3-0.4	0.012-0.016

Pinion Gear Clearance

Description	mm	in.
Pinion gear clearance	0.635	0.025

Propeller Shaft End Play

Description	mm	in.
Propeller Shaft End Play	0.025-0.030	0.001-0.012

Gear Ratio - Teeth per Gear (Gear Housing)

RATIO	DRIVE	DRIVEN
2.43:1	13	24
2.20:1	16	27
2.00:1	16	27
1.81:1	16	27
1.65:1	18	25
1.50:1	15	19
1.36:1	15	19

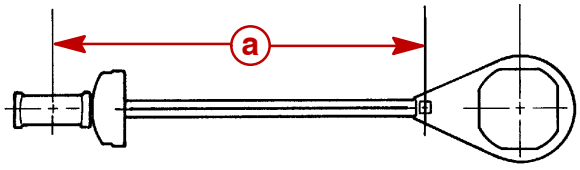
Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

Description	Nm	lb-in.	lb-ft
Drive shaft pinion gear (bolt)	61		45
Bearing carrier (left-hand thread)	203		150
Outer propeller shaft bearing retainer nut (left-hand thread)	271		200
Drive shaft housing to gear housing nuts and bolt	47.5		35
Anode plate	27		20
Front propeller nut	136		100
Rear propeller nut	81		60
Rolling preload of drive shaft	0.3-0.6	3-5	

Torque Conversion Chart For Bearing Carrier

Torque Wrench Length		Torque Wrench Reading in lb-ft (Nm) to Achieve 150 lb-ft (203 Nm)	
mm	in.	Nm	lb-ft
381	15	165	122
406	16	167	123
432	17	168	124
457	18	171	126
483	19	172	127
508	20	174	128
533	21	175	129
559	22	175	129
584	23	176	130
610	24	178	131
635	25	179	132
660	26	179	132
686	27	180	133
711	28	180	133
737	29	182	134
762	30	182	134
787	31	183	135
813	32	183	135
838	33	184	136
864	34	184	136
889	35	184	136
914	36	186	137

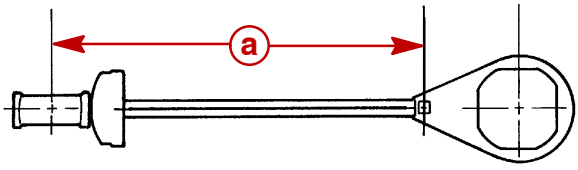


72209

a - Torque wrench length

Torque Conversion Chart For Bearing Retainer Nut

Torque Wrench Length		Torque Wrench Reading in lb-ft (Nm) to Achieve 200 lb-ft (271 Nm)	
mm	in	Nm	lb-ft
381	15	220	162
406	16	222	164
432	17	225	166
457	18	226	167
483	19	229	169
508	20	230	170
533	21	232	171
559	22	235	173
584	23	236	174
610	24	237	175
635	25	237	175
660	26	239	176
686	27	240	177
711	28	241	178
737	29	241	178
762	30	243	179
787	31	244	180
813	32	244	180
838	33	245	181
864	34	245	181
889	35	247	182
914	36	247	182



72209

a - Torque wrench length

Torquing Outer Prop Shaft Bearing Retainer and Bearing Carrier

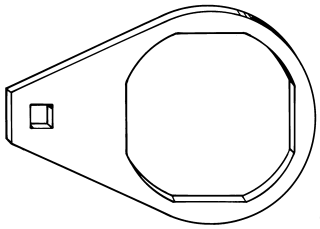
Use the following procedure to allow torquing outer prop shaft bearing retainer and bearing carrier with a torque wrench.

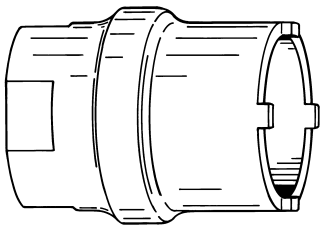
1. On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.
2. On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (2 bands, etc.).

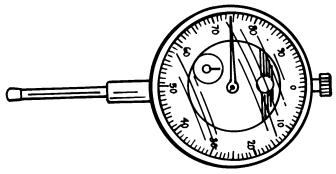
Lubricants / Sealants / Adhesives

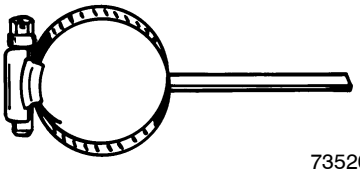
Description	Where Used	Part Number
Bellows Adhesive	Water passage O-ring and oil passage quad ring	92-86166Q1
	Outer diameter of seal	
Needle Bearing Assembly Lubricant	Needle bearings	92-802868A1
Loctite 271 Threadlocker	Inner propeller shaft seal	92-809819
	Outer diameter of oil seal	
	Threads of pinion screw	
High-Performance Gear Lube	Inner diameter of roller bearing	92-802854A1
	Outer diameter of bearing cup	
	Outside casing diameter	
	Front gear	
	Rear gear	
	Drive gear	
	All bearings	
	Bearing retainer nut	
	Inner diameter of small roller tapered bearing	
	Inner diameter of large roller tapered bearing	
2-4-C with Teflon	Inner propeller shaft seal	92-802859A1
	Outer propeller shaft seal	
	Inner and outer propeller shaft	
	Thrust race	
Perfect Seal	Bearing carrier	92-34227-1
	Tapered surface of bearing carrier that comes in contact with housing	
Special Lubricant 101	Lips of oil seal and fill area between lips of seal	92-802865A1
	Area between outer propeller shaft seal lips	
	Threads and O-ring surface area of bearing carrier and area between seals	
	Inner and outer propeller shaft	
Anti-Corrosion Grease	Inner and outer propeller shaft	92-802867A1

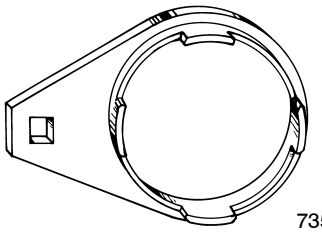
Special Tools

Bearing Carrier Tool		
 73495	Use with 91-805382T Bearing Retaining Tool to remove propeller shaft retainer nut in the Bravo Three sterndrive units.	91-805374

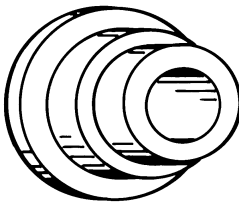
Bearing Retainer Tool		
 73515	Installs the bearing retainer on the Bravo Three sterndrive units.	91-805382T

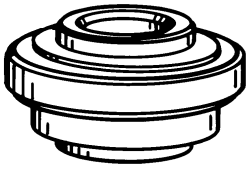
Dial Indicator		
 73429	Measures the gear backlash on all the Bravo sterndrive units.	91-58222A1

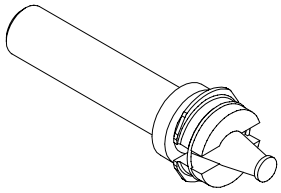
Spline Backlash Tool		
 73520	Measures the Bravo Three propshaft-to-gear spline backlash while on V-blocks.	91-806192

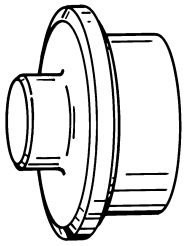
Bearing Carrier Tool		
 73500	Installs and removes the bearing carrier on the Bravo Three sterndrive units.	91-805374-1

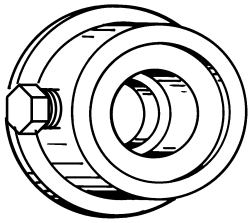
Special Tools (continued)

Bearing Driver, Outer Propeller Shaft Bearing		
 73510	Installs the roller bearing in outer propeller shaft of the Bravo Three sterndrive units.	91-805352T

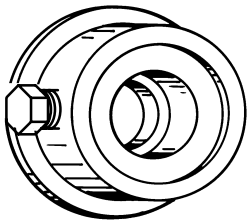
Seal Driver, Outer Propeller		
 73516	Installs the seals in outer propeller shaft of the Bravo Three sterndrive units.	91-805358T

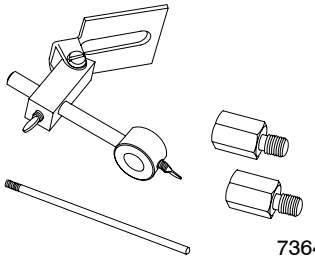
Seal Removal Tool		
 78062	Use to remove the needle bearing and oil seals in the bearing carrier of all the Bravo Three sterndrive units. 25-805048 Replacement O-ring.	91-862064A1

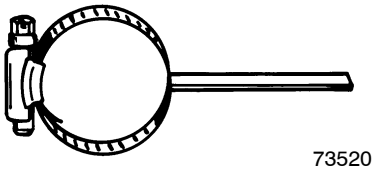
Bearing Carrier Tool		
 73499	Installs the needle bearing in the Bravo Three sterndrive unit bearing carriers.	91-805356

Drive Shaft Retaining Tool		
 78078	Holds bearings and the drive shaft in Bravo Three sterndrive units, Serial Number 0L999999 and Below, while checking backlash.	91-805381

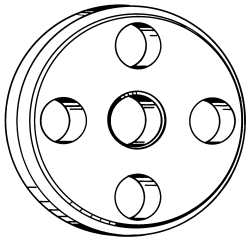
Special Tools (continued)

Drive Shaft Retaining Tool		
 78078	Use to hold the bearings and the lower drive shaft while checking backlash on the Bravo Three sterndrive units.	91-863738

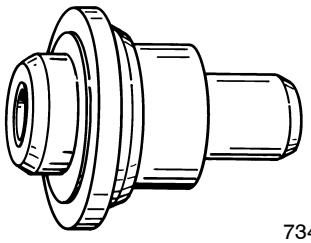
Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-83155

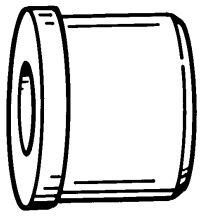
Backlash Indicator Rod		
 73520	Indicates the inner propeller shaft backlash on the Bravo Three sterndrive units.	91-805481

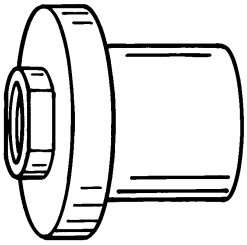
Driver Handle		
73504	Driver handle for the 91-805470 Front Bearing Guide of the Bravo One, Bravo Three, and Bravo 2000 sterndrive units.	91-805454

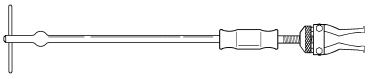
Vertical Guide Tool		
 73501	Aligns the tools in the vertical bore of all Bravo sterndrive units.	91-805458

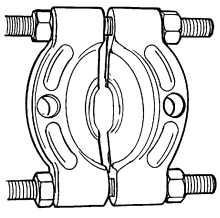
Special Tools (continued)

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

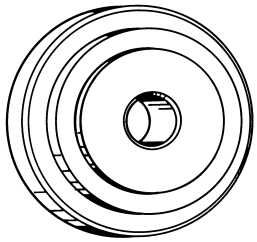
Bearing Driver		
 73447	Installs and removes the lower drive shaft pinion bearing on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-63638T

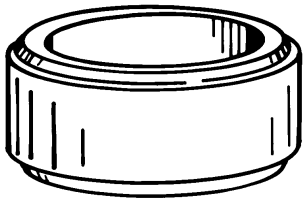
Bearing Driver		
 73462	Installs the drive shaft needle bearings on all the Bravo sterndrive units.	91-89867T

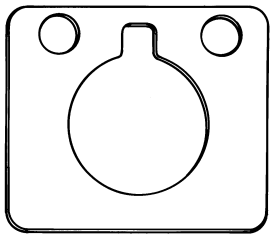
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

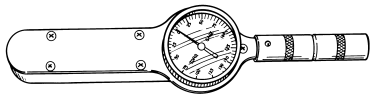
Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

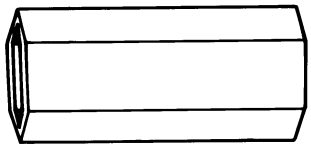
Special Tools (continued)

Bearing Carrier Seal Driver		
 73526	Installs the seals in the Bravo Three sterndrive unit bearing carriers.	91-805372

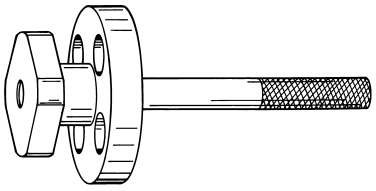
Bearing Cup Driver		
 73460	Installs the drive shaft bearing cup in the gear housing and bearing cup in the bearing carrier of the Bravo One and Bravo Two sterndrive units.	91-67443T

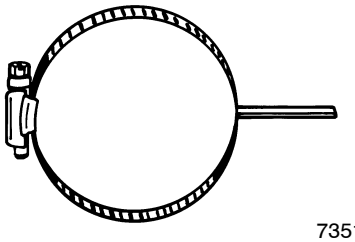
Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo sterndrive units.	91-61077T

Special Tools (continued)

Shimming Tool		
 73503	Measures the pinion height on the Bravo Three sterndrive units.	91-805462T

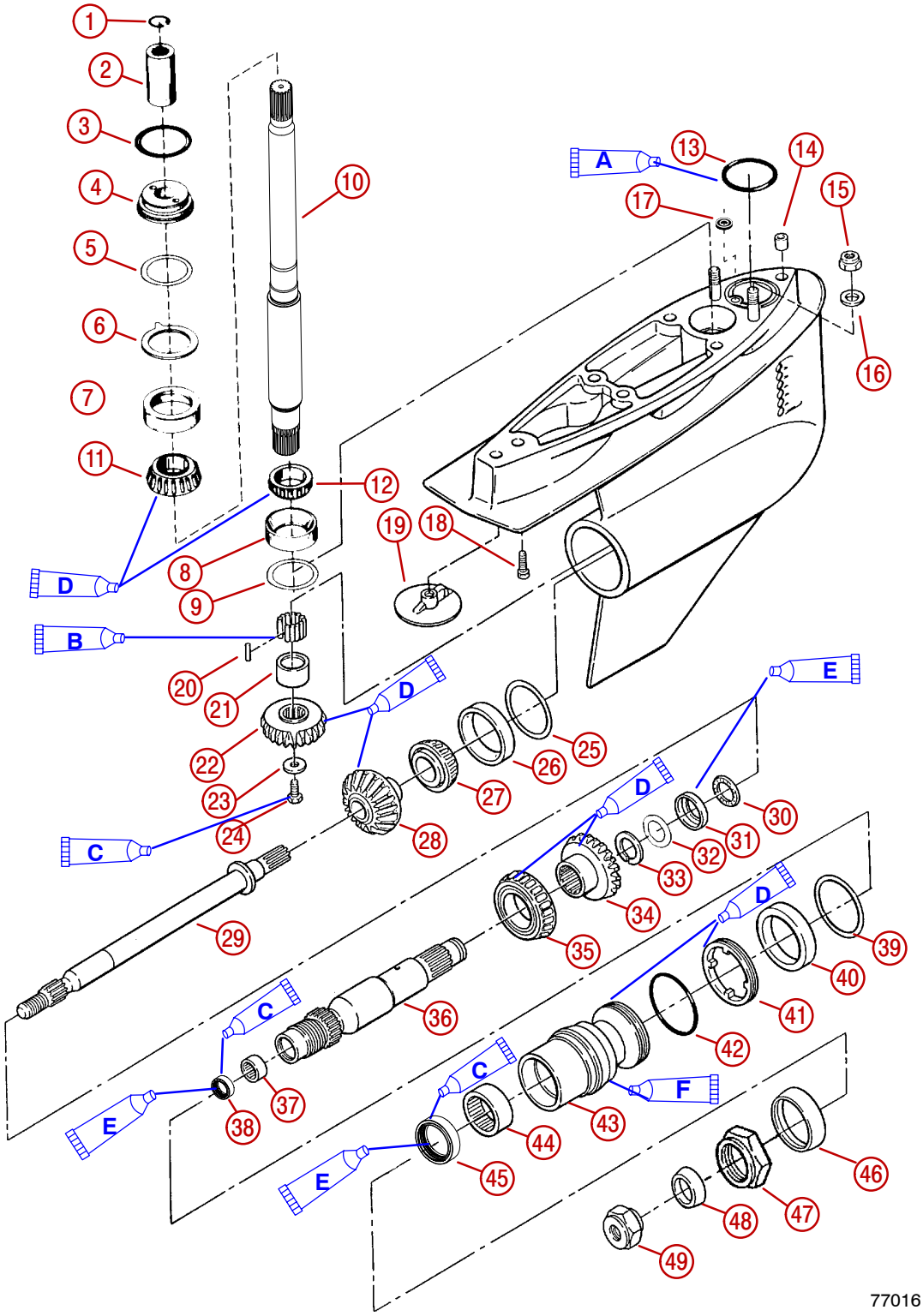
Back Lash Indicator Rod		
 73517	Indicates the outer propeller shaft backlash on the Bravo Three sterndrive units.	91-805482

NOTE: *Puller Shaft 91-31229 included in Bearing Removal and Installation Tool Assembly 91-31229A7.*

NOTE: *Driver Head Rod 91-37323 included in Bearing Removal and Installation Tool Assembly 91-31229A7.*

Bravo Three Gear Housing Exploded View

Drive Shaft and Propeller Shaft Components



77016

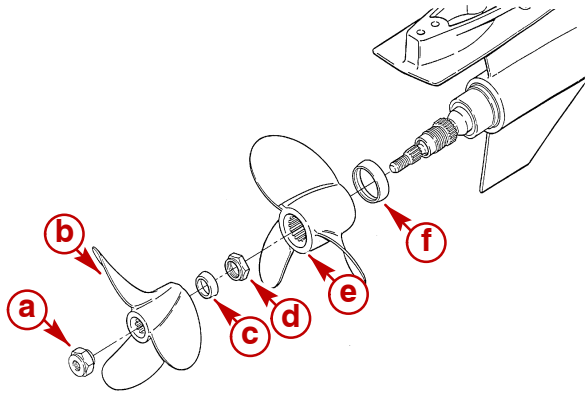
Drive Shaft and Propeller Shaft Components (continued)

1 - Retainer
2 - Coupler
3 - O-ring
4 - Spacer
5 - Shims
6 - Tab washer
7 - Bearing cup
8 - Bearing cup
9 - Shims
10 - Drive shaft
11 - Tapered roller bearing (larger diameter)
12 - Tapered roller bearing (smaller diameter)
13 - O-ring
14 - Seal
15 - Locknut
16 - Flat washer
17 - Oil passage quad ring
18 - Screw
19 - Anodic plate
20 - Needle bearings
21 - Bearing race
22 - Pinion (drive) gear
23 - Washer
24 - Pinion bolt
25 - Shims
26 - Bearing cup
27 - Tapered bearing
28 - Front gear
29 - Inner propeller shaft
30 - Thrust bearing
31 - Thrust race
32 - Shim (prop shaft end-play)
33 - Snap ring
34 - Rear gear
35 - Tapered bearing
36 - Outer propeller shaft
37 - Bearing
38 - Inner propeller shaft seal
39 - Shims
40 - Bearing cup
41 - Bearing retainer
42 - O-ring
43 - Bearing carrier
44 - Bearing
45 - Outer propeller shaft seal
46 - Front propeller thrust washer
47 - Front propeller locknut
48 - Rear propeller thrust washer
49 - Rear propeller locknut

Description		Where Used	Part Number
A	Bellows Adhesive	O-ring	92-86166Q1
B	Needle Bearing Assembly Lubricant	Needle bearings	92-809819
C	Loctite 271 Threadlocker	Inner propeller shaft seal	92-8009819
		Outer propeller shaft seal	
		Pinion Bolt	
D	High Performance Gear Lube	All bearing surfaces	92-802854A1
		Drive gear	
		Front gear	
		Rear gear	
		Tapered roller bearings	
		Bearing retainer	
E	2-4-C with Teflon	Inner propshaft seal	92-802859A1
		Outer propshaft seal	
		Thrust race	
F	Perfect Seal	Bearing carrier	92-34227-1

Pre-Disassembly Inspection

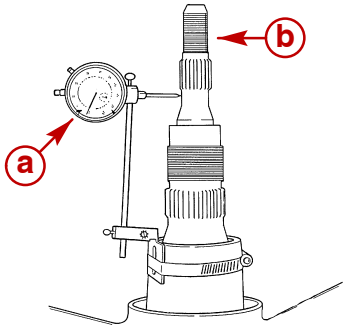
1. Remove propellers.



75899

a - Rear propeller nut
b - Rear propeller
c - Rear thrust ring
d - Front propeller nut
e - Front propeller
f - Front thrust ring

2. Position unit with shafts positioned up**.**
3. Position dial indicator on inner propeller shaft.
4. Rotate inner propeller shaft while observing dial indicator. If deflection is more than 0.127 mm (0.005 in.), a bent inner propeller shaft is indicated.

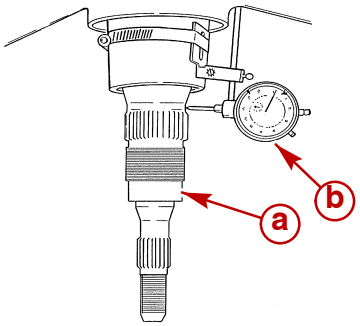


75900

a - Dial indicator
b - Inner propeller shaft

5. Position unit with shafts positioned down.
6. Position dial indicator on outer propeller shaft.

7. Rotate outer propeller shaft while observing dial indicator. If deflection is more than 0.254 mm (0.010 in.), a bent outer propeller shaft is indicated.



75901

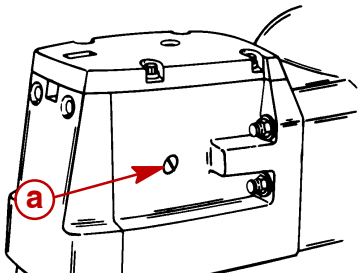
a - Dial indicator
b - Outer propeller shaft

Drive Shaft Housing and Gear Housing Separation

⚠ CAUTION

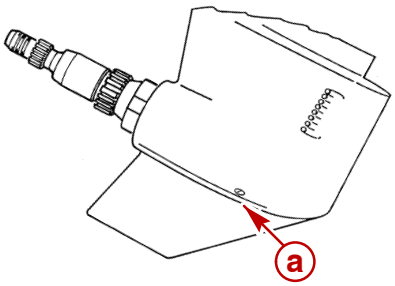
ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

1. Remove, empty, and clean gear lube monitor.
2. Remove vent plug.



a - Vent plug

3. Drain sterndrive unit at fill/drain screw.



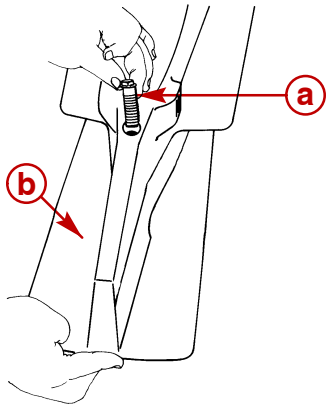
72522

a - Fill/drain screw

4. Remove anodic plate.

a. Remove the rubber cap to gain access to the anode attaching bolt.

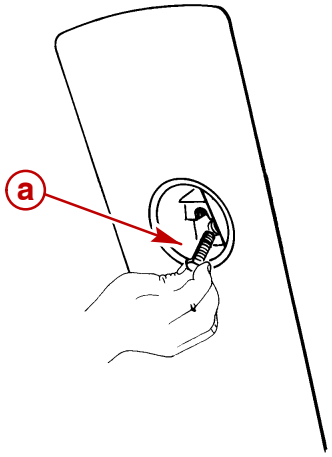
b. Remove the bolt.



76832

a - Bolt

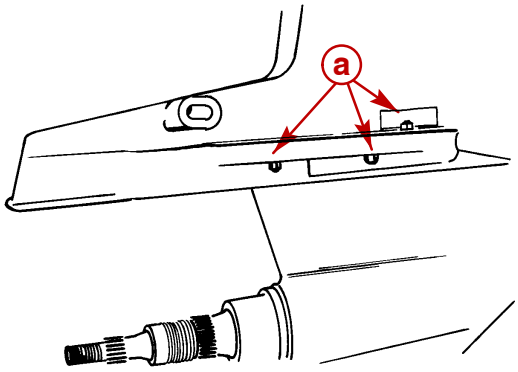
c. Remove the bolt in the anode cavity.



76804

a - Bolt

d. Remove the locknuts and flat washers.



76803

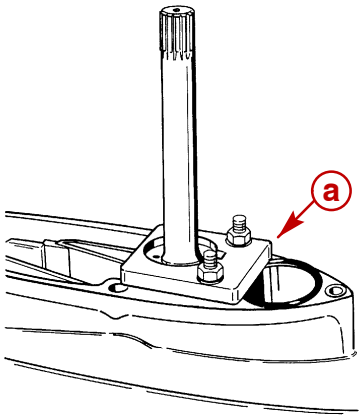
a - Locknuts and flat washers (6)

Gear Housing Disassembly

⚠ CAUTION

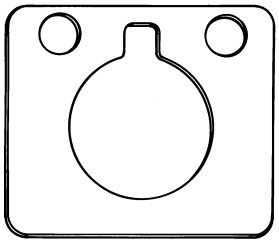
Clamp Plate must be installed on gear housing when gear housing is separated from drive shaft housing.

1. Install Clamp Plate, nuts, and 4 washers on gear housing. Tighten securely.



72241

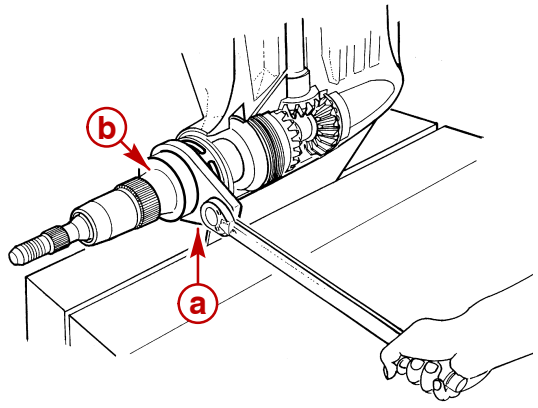
a - Clamp Plate

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

⚠ CAUTION

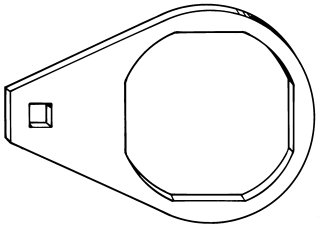
Bearing carrier has a LEFT HAND THREAD. Remove by turning CLOCKWISE.

2. Remove bearing carrier by turning CLOCKWISE and using Bearing Carrier Tool. Use a torch lamp to heat area where the carrier and housing meet to ease removal.



75895

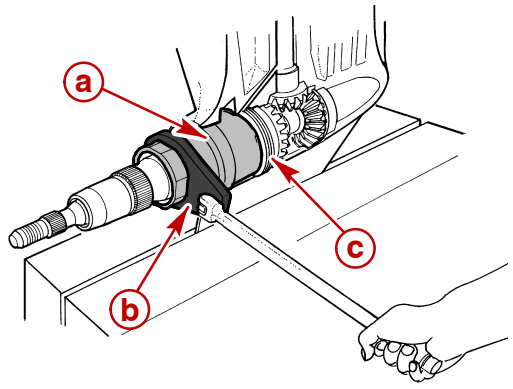
a - Bearing Carrier Tool
b - Bearing carrier

Bearing Carrier Tool		
 73495	Installs and removes the bearing carrier on the Bravo Three sterndrive units.	91-805374-1

⚠ CAUTION

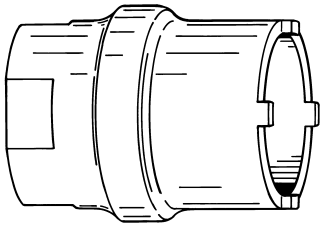
Outer propeller shaft bearing retainer has a LEFT HAND THREAD. Remove by turning CLOCKWISE.

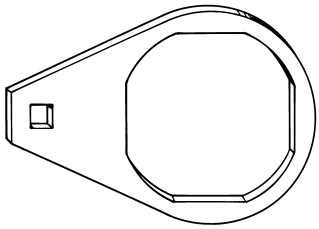
3. Remove outer propeller shaft bearing retainer by turning CLOCKWISE and using Bearing Retainer Tool.



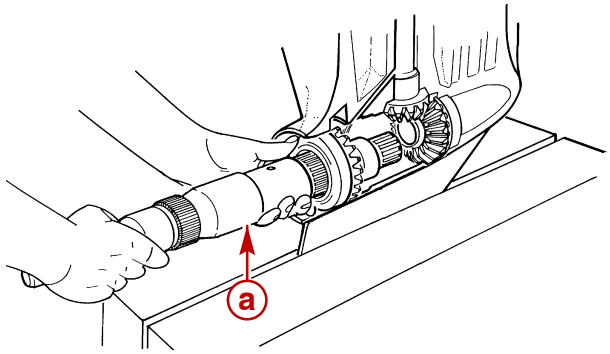
75898

a - Bearing Retainer Tool
b - Bearing Carrier Tool
c - Bearing retainer

Bearing Retainer Tool		
 73515	Installs the bearing retainer on the Bravo Three sterndrive units.	91-805382T

Bearing Carrier Tool		
 73495	Use with 91-805382T Bearing Retaining Tool to remove propeller shaft retainer nut in the Bravo Three sterndrive units.	91-805374

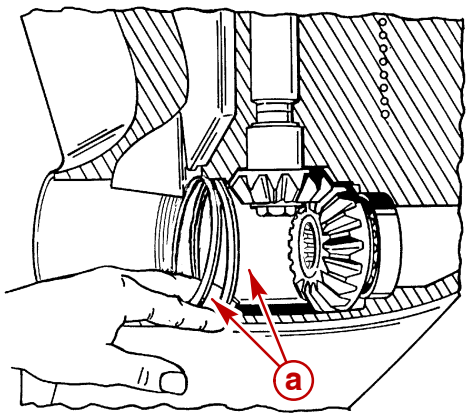
4. Remove inner and outer propeller shaft assembly from gear housing.



72244

a - Inner and outer propeller shaft assembly

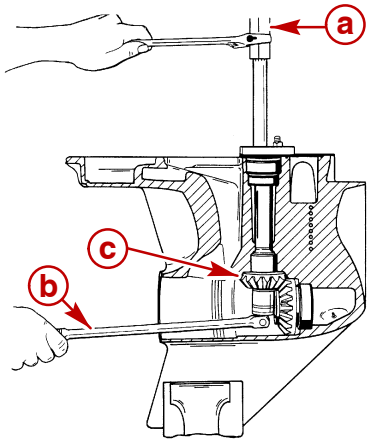
5. Remove shims from gear housing.



72245

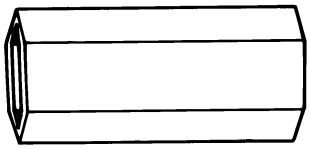
a - Shims

6. Remove drive shaft pinion gear retaining bolt and washer using Drive Shaft Adapter.

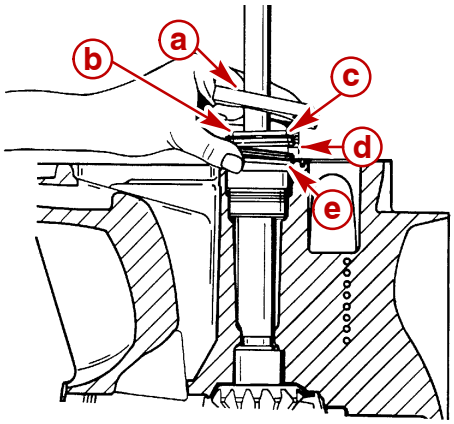


72246

a - Drive Shaft Adapter
b - Breaker bar and socket
c - Pinion gear

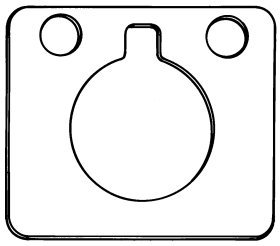
Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo sterndrive units.	91-61077T

7. Remove Clamp Plate, then remove O-ring, spacer, shims and tab washer.



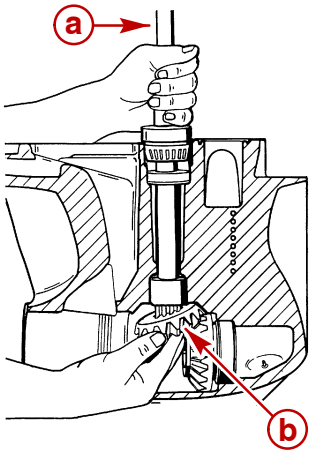
72247

a - Clamp Plate
b - O-ring
c - Spacer
d - Shims
e - Tab washer

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

8. Remove drive shaft and pinion gear.

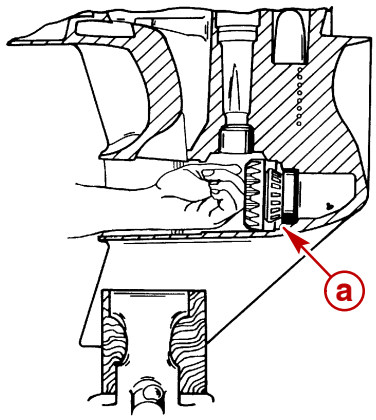
NOTE: *Be careful not to lose rollers from drive shaft pinion bearing should they drop during drive shaft removal.*



72248

a - Drive shaft
b - Drive shaft pinion gear

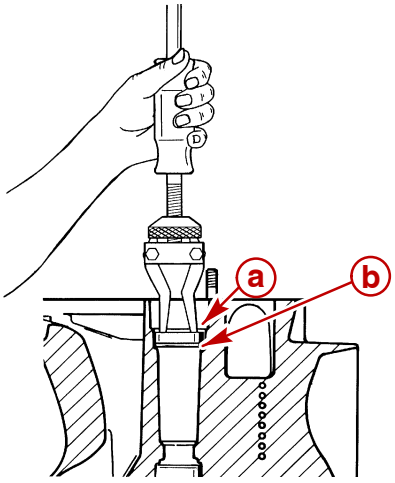
9. Remove front driven gear and bearing from gear housing.



72249

a - Front pinion gear and bearing

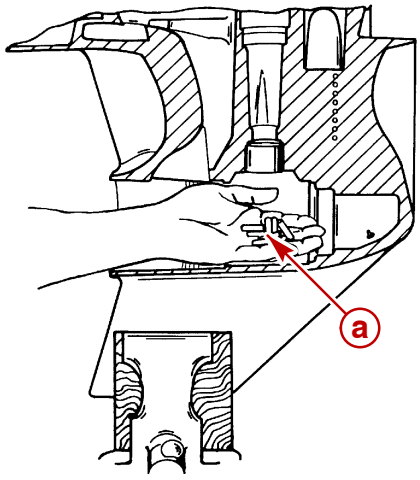
10. Remove drive shaft bearing cup and shims.



72250

a - Bearing cup
b - Shims

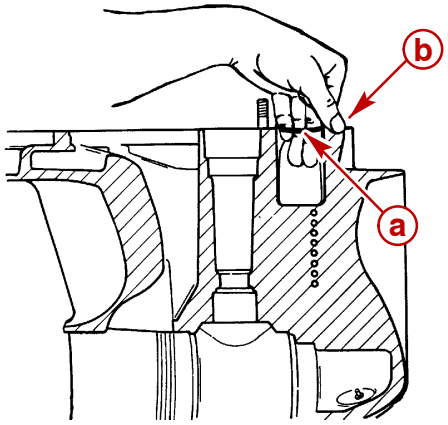
11. Unless you intend to remove the entire pinion bearing, remove needle bearings from pinion bearing race. Refer to **Pinion Bearing Removal**.



72251

a - Needle bearings

12. Remove water passage O-ring and oil passage quad ring.



72252

a - Water passage O-ring
b - Oil passage quad ring

Drive Shaft And Pinion Bearing

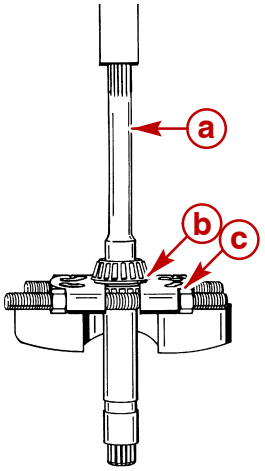
Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replace drive shaft if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

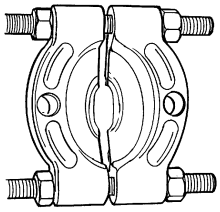
NOTE: *Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removed.*

1. Press tapered roller bearing from shaft using Universal Puller Plate to support bearing.
2. Remove second tapered roller bearing in the same manner.



72442

a - Drive shaft
b - Bearing
c - Universal Puller Plate

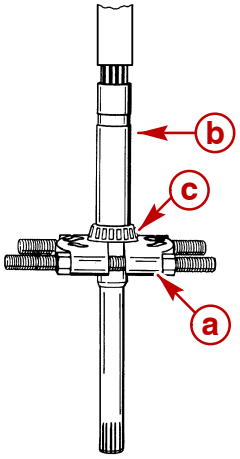
Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Drive Shaft Reassembly

1. Lubricate inner diameter of small tapered roller bearing.

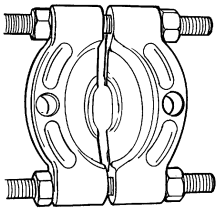
Description	Where Used	Part Number
High Performance Gear Lube	Inner diameter of small tapered roller bearing	92-802854A1

2. Press small tapered roller bearing onto drive shaft using Universal Puller Plate. Ensure that smaller outer diameter faces pinion end of shaft.



72444

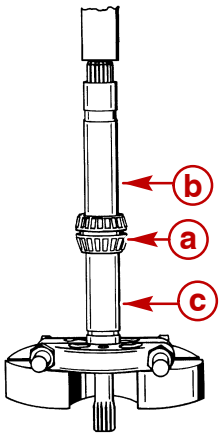
a - Universal Puller Plate
b - Drive shaft
c - Small tapered roller bearing

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

3. Lubricate inner diameter of large tapered roller bearing.

Description	Where Used	Part Number
High Performance Gear Lube	Inner diameter of large tapered roller bearing	92-802854A1

4. Press large tapered roller bearing onto drive shaft using suitable mandrel or old bearing race on inner race. Ensure that larger outer diameter faces pinion end of shaft.



72445

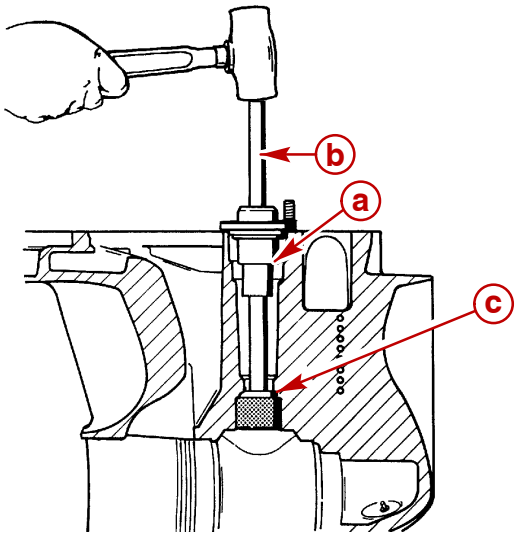
a - Suitable mandrel
b - Drive shaft
c - Large tapered roller bearing

Pinion Bearing

Removal

IMPORTANT: All needle bearings must be in place inside bearing casing while driving pinion bearing from gear housing or bearing casing will bend or break and become difficult to remove.

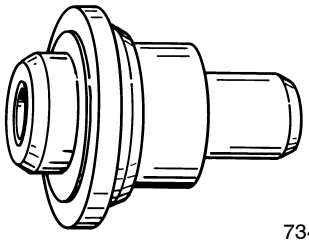
1. Remove pinion bearing using Bearing Driver and Driver Head Rod. Use Seal Driver as a pilot. Heat bearing area of housing to approximately 93.3 degree C (200 degree F) to ease removal. Do not use open flame.

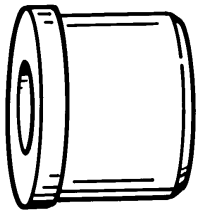


72253

a - Seal Driver
b - Driver Head Rod
c - Bearing Driver

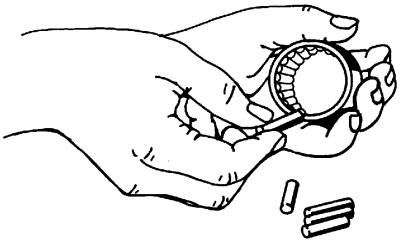
NOTE: *Driver Head Rod 91-37323 included in Bearing Removal and Installation Tool Assembly 91-31229A7.*

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

Bearing Driver		
 73447	Installs and removes the lower drive shaft pinion bearing on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-63638T

Installation

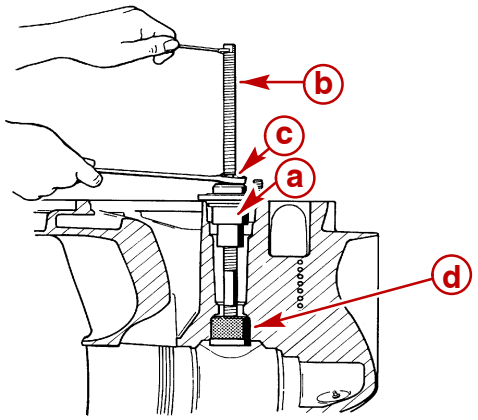
1. Install needles in casing. Use lubricant to help keep needles in place.
2. Position bearing assembly over Bearing Driver with number on bearing casing facing up. Lubricate casing outer diameter.



72443

Description	Where Used	Part Number
Needle Bearing Assembly Lubricant	Needle bearings	92-802868A1
High-Performance Gear Lube	Outside casing diameter	92-802854A1

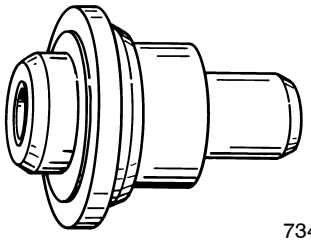
3. Install pinion bearing.

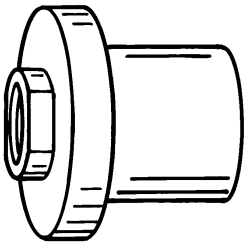


72254

a - Seal Driver (used as pilot)
b - Puller shaft
c - Washer and nut
d - Bearing driver

NOTE: *Puller Shaft 91-31299 included in Bearing Removal and Installation Tool Assembly 91-31229A7.*

Seal Driver		
 73453	Installs the U-joint oil seal into the bearing carrier. Also use to pilot the puller rod for the gear housing needle bearing installation on all the Bravo sterndrive units.	91-813653T

Bearing Driver		
 73462	Installs the drive shaft needle bearings on all the Bravo sterndrive units.	91-89867T

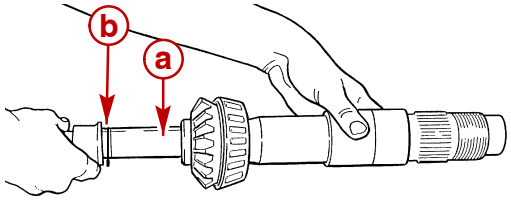
Propeller Shaft

Inspection

1. Inspect for bent or twisted splines.
2. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Replace shaft and oil seals if any grooves are found.
3. Inspect needle bearing race on outer propeller shaft and bearing surface of inner propeller shaft for pitting, grooves, discoloration, or embedded particles. If any of these conditions exist, replace shaft.
4. Condition of the bearing surfaces on the outer propeller shaft and inner propeller shaft is an indication of the condition of the bearings in the bearing carrier and outer propeller shaft. Inspect bearing rollers for pitting, grooves, discoloration, or embedded particles. If any of these conditions exist, replace bearings and shaft.
5. Inspect outer propeller shaft tapered bearing and bearing cup. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.

Disassembly

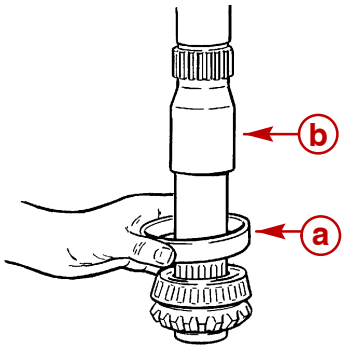
1. Remove inner propeller shaft and thrust bearing from assembly.



72255

a - Inner propeller shaft
b - Thrust bearing

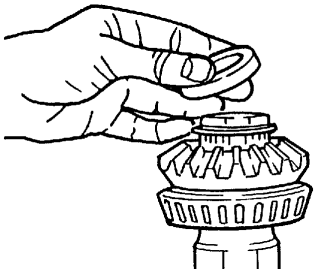
2. Remove bearing cup from outer propeller shaft.



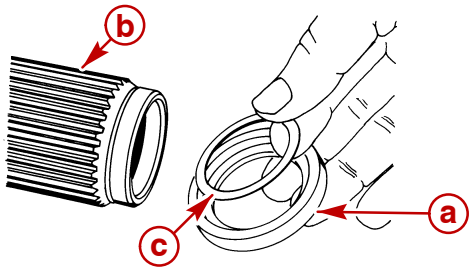
72256

a - Bearing cup
b - Outer propeller shaft

3. Remove thrust cap and shims using a punch and hammer. Align punch with opening in snap ring.



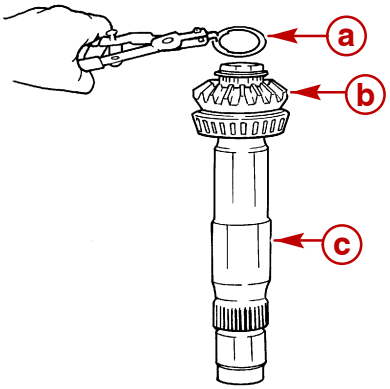
72212



71799

a - Thrust cap
b - Outer propeller shaft
c - Shim

4. Remove snap ring and driven gear and bearing assembly from outer propeller shaft.

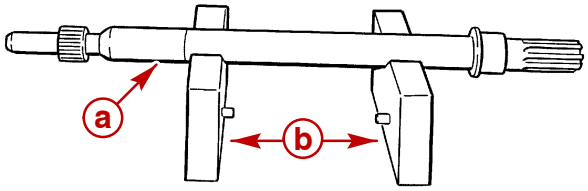


72213

a - Snap ring
b - Driven gear and bearing assembly
c - Outer propeller shaft

Propeller Shaft Spline Lash Check

1. Place propeller shaft on 2 V-blocks.

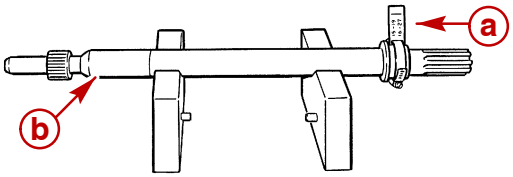


72229

Inner propeller shaft shown, outer similar

a - Propeller shaft
b - V-blocks

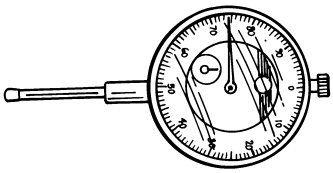
2. Install indicator rod on inner propeller shaft just behind shaft spline.

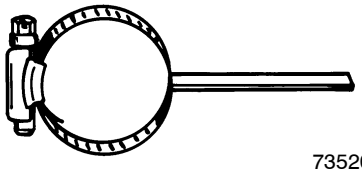


72230

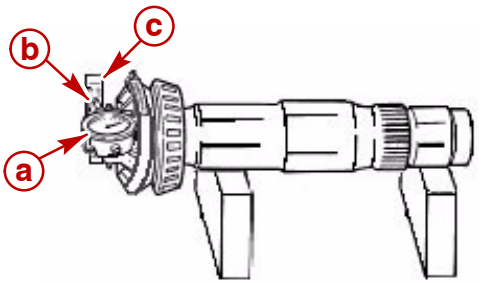
Inner propeller shaft shown, outer similar

a - Indicator rod
b - Propeller shaft

Dial Indicator		
 73429	Measures the gear backlash on all the Bravo sterndrive units.	91-58222A1

Spline Backlash Tool		
 73520	Measures the Bravo Three propshaft-to-gear spline backlash while on V-blocks.	91-806192

3. Slide front driven gear assembly on spline of inner propeller shaft.
4. Mount Dial Indicator to gear and position so that indicator probe aligns with mark on indicator rod.



79224

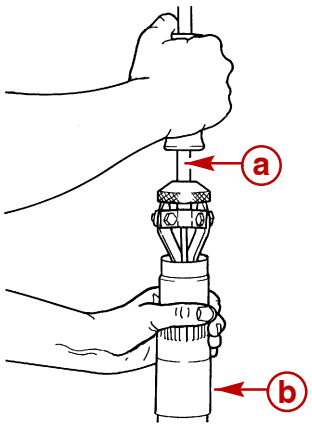
Outer propeller shaft shown, inner similar

a - Dial Indicator
b - Spline Backlash Tool
c - Mark stamped on indicator rod

5. Rotate gear back and forth while observing Dial Indicator. Record spline lash reading (for use later in this section). This reading is required to determine true backlash between pinion and driven gear.

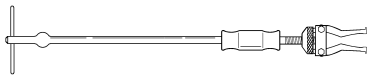
Outer Propeller Shaft Servicing

1. Remove roller bearing and oil seal from outer propeller shaft using Slide Hammer Puller with three-jaw puller.

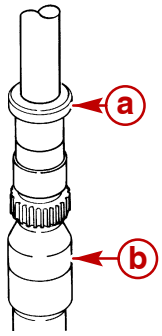


72216

a - Slide Hammer Puller
b - Outer propeller shaft

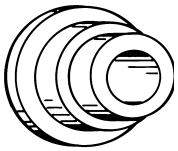
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

2. Install roller bearing using Bearing Driver.

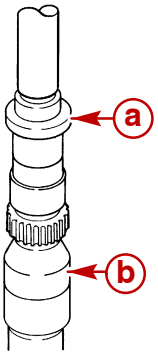


72217

a - Bearing Driver
b - Outer propeller shaft

Bearing Driver, Outer Propeller Shaft Bearing		
 73510	Installs the roller bearing in outer propeller shaft of the Bravo Three sterndrive units.	91-805352T

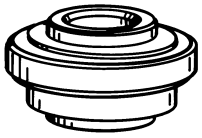
3. Lubricate outer diameter of oil seal.
4. Press oil seal into outer propeller shaft using Seal Driver until tool seats against shaft.
5. Lubricate lips of oil seal and fill area between lips of seal.



72235

a - Seal Driver
b - Outer propeller shaft

Description	Where Used	Part Number
Loctite 271 Threadlocker	Outer diameter of oil seal	92-809819
Special Lubricant 101	Lips of oil seal and fill area between lips of seal	92-802865A1

Seal Driver, Outer Propeller		
 73516	Installs the seals in outer propeller shaft of the Bravo Three sterndrive units.	91-805358T

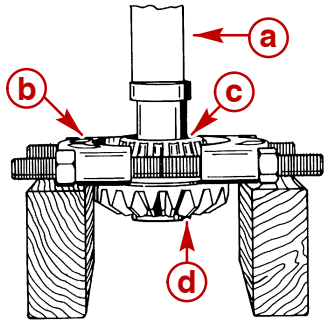
Front Driven Gear And Bearing

Inspection

1. Inspect driven gears for pitting, chipped or broken teeth, and excessive or uneven wear. If any of these conditions exist, replace both gear and bearing assemblies and drive shaft pinion gear.
2. Replace tapered roller bearings and cups if cups are pitted, grooved, scored, worn uneven, discolored from overheating, or have metal particles embedded in the cups.

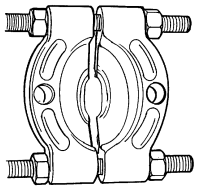
Bearing Removal

1. If you determine that bearings are in need of replacement and the gears are still in good condition, remove bearings from gears using Universal Puller Plate and a suitable mandrel (bearings are damaged in removal and should not be reused).



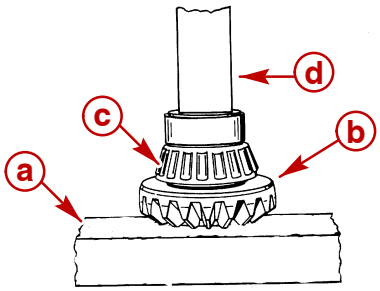
72446

a - Suitable mandrel
b - Universal Puller Plate
c - Tapered roller bearing by inspection
d - Driven gear

Universal Puller Plate		
 73652	Removes the gears and bearings.	91-37241

Bearing Installation

1. Lubricate inner diameter of new bearing.
2. Place a suitable mandrel (old bearing race) against inner bearing race.
3. Place another mandrel on face of gear and press gear and bearing together.



72447

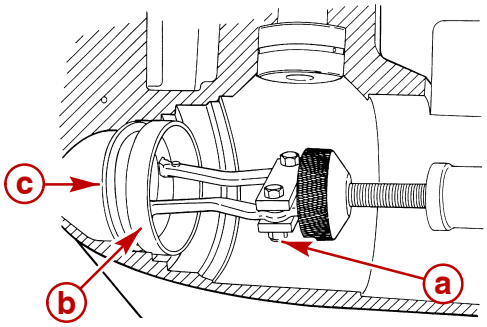
a - Metal block
b - Driven gear
c - Roller bearing
d - Mandrel - contacting inner race

Description	Where Used	Part Number
High Performance Gear Lube	Inner diameter of new bearing	92-802854A1

Bearing Cup Removal

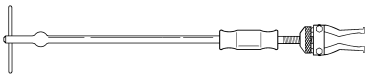
1. Remove bearing cup and shims using Slide Hammer Puller.
2. Measure shims for reassembly reference.

NOTE: *When pulling bearing cup with Puller, shims will be damaged. Do not reuse shims.*



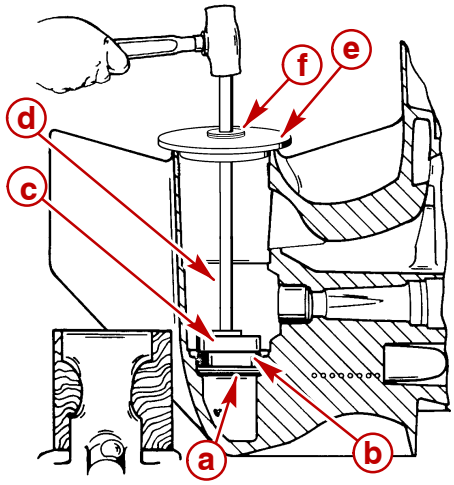
19808

a - Slide Hammer Puller
b - Bearing cup
c - Shims

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

Bearing Cup Installation

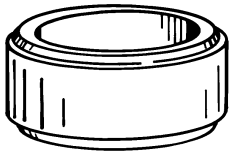
1. Ensure cup is not canted.
2. Lubricate bearing cup outer diameter.
3. Install front driven gear bearing cup and original thickness shims using Bearing Cup Driver and Driver Handle. If shims were lost or damaged where original thickness cannot be determined, install a 0.015 in. (0.38 mm) shim for a starting point.



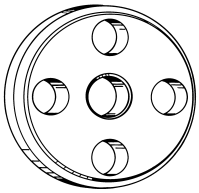
75958

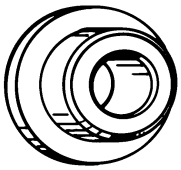
a - Shims
b - Bearing cup
c - Bearing Cup Driver
d - Old propeller shaft or Driver Handle
e - Guide plate
f - Guide Insert

Description	Where Used	Part Number
High Performance Gear Lube	Outer diameter of bearing cup	92-802854A1

Bearing Cup Driver		
 73460	Installs the drive shaft bearing cup in the gear housing and bearing cup in the bearing carrier of the Bravo One and Bravo Two sterndrive units.	91-67443T

Driver Handle		
73504	Driver handle for the 91-805470 Front Bearing Guide of the Bravo One, Bravo Three, and Bravo 2000 sterndrive units.	91-805454

Vertical Guide Tool		
 73501	Aligns the tools in the vertical bore of all Bravo sterndrive units.	91-805458

Guide Insert		
 76044	Use with Vertical Guide Tool 91-805458 and Vertical Shaft 91-805474.	91-805473

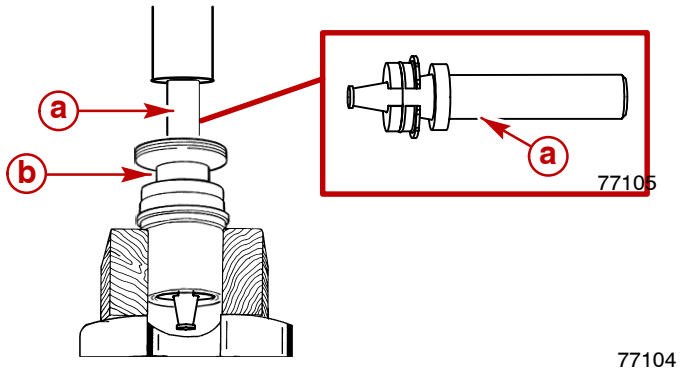
Bearing Carrier Seal And Bearing

Inspection

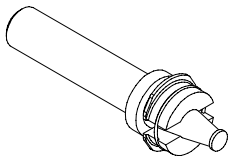
1. Inspect bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.
2. Inspect needle bearing for pitting, grooves, discoloration, or embedded particles. If any of these conditions exist, replacement is necessary.

Removal

1. Press seal from carrier using Seal Removal Tool.

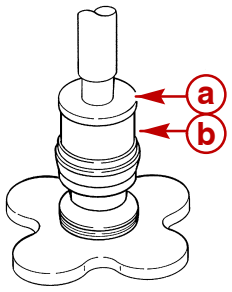


a - Seal Removal Tool
b - Bearing carrier

Seal Removal Tool		
 78062	Use to remove the oil seal in the bearing carrier of all the Bravo Three sterndrive units. 25-805048 Replacement O-ring.	91-862064A1

Installation

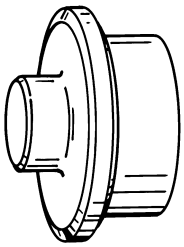
1. Lubricate bearing.
2. Install roller bearing using Bearing Carrier Tool .



75896

a - Bearing Carrier Tool
b - Bearing carrier

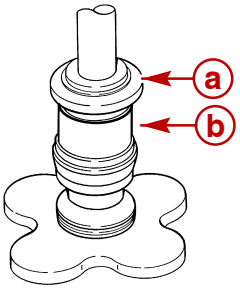
Description	Where Used	Part Number
High Performance Gear Lube	Bearing	92-802854A1

Bearing Carrier Tool		
 73499	Installs the needle bearing in the Bravo Three sterndrive unit bearing carriers.	91-805356

3. Apply sealant to outer diameter of oil seal.

Description	Where Used	Part Number
Loctite 271 Threadlocker	Outer diameter of oil seal	92-809819

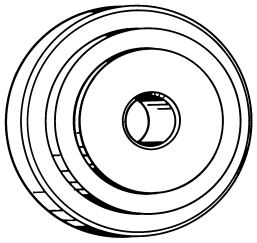
4. Press oil seal into bearing carrier using Bearing Carrier Seal Driver until tool seats against housing.
5. Lubricate lips of oil seal and the area between the lips of the seal.



75897

a - Bearing Carrier Seal Driver
b - Bearing carrier

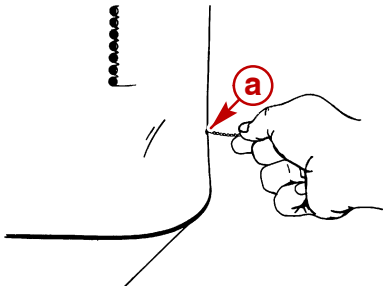
Description	Where Used	Part Number
Special Lubricant 101	Lips of oil seal and fill area between lips of seal	92-802865A1

Bearing Carrier Seal Driver		
 73526	Installs the seals in the Bravo Three sterndrive unit bearing carriers.	91-805372

Speedometer Water Passage

Inspection and Cleaning

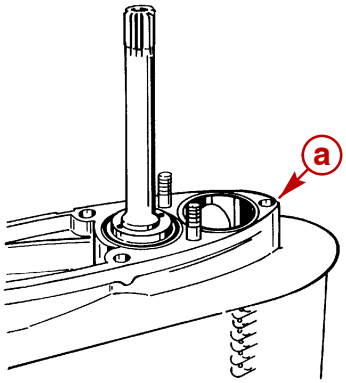
1. Inspect pitot tube opening on leading edge of gear housing for obstruction.
2. Clean opening with a short piece of wire, if necessary.
3. If obstruction cannot be removed with wire, carefully reopen tube using a 2 mm (5/64 in.) diameter drill bit. Do not drill beyond a depth of 62 mm (2-7/16 in.).



72448

a - Pitot tube opening

4. Inspect speedometer water passage seal for nicks, cuts, or distortion. Replace if necessary.

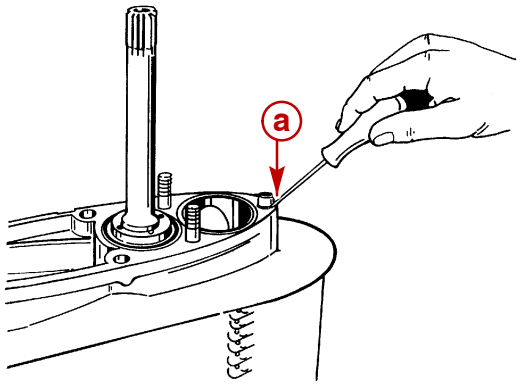


72449

a - Speedometer water passage seal

Seal Removal

1. Pry speedometer water passage seal out with a suitable tool.

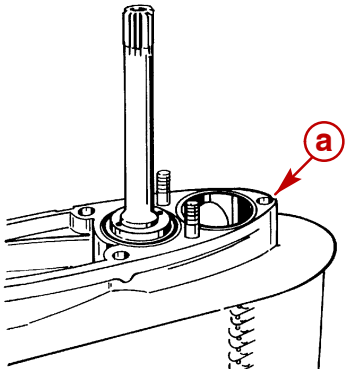


72450

a - Speedometer water passage seal

Seal Installation

1. Apply adhesive to outer diameter of seal and install in speedometer water passage bore.
2. Ensure top edge of seal is flush with gear housing surface.



72449

a - Seal

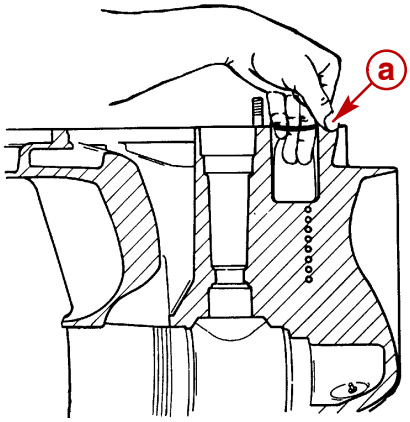
Description	Where Used	Part Number
Bellows Adhesive	Outer diameter of seal	92-86166Q1

Gear Housing Reassembly and Shimming

1. Lubricate all bearings before installing. Components must be lubricated to obtain accurate bearing preload readings.

Description	Where Used	Part Number
High Performance Gear Lube	All bearings	92-802854A1

2. Install water passage O-ring and oil passage quad ring. Hold in place using adhesive.



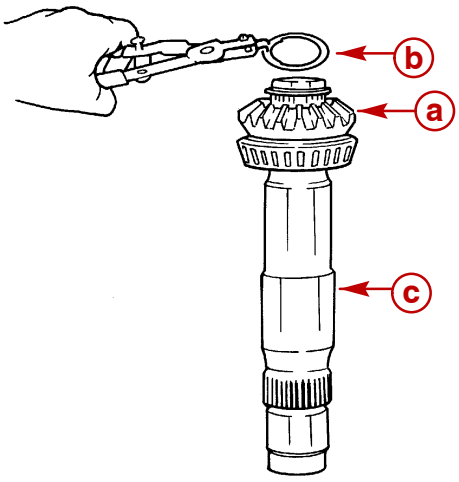
72252

a - Water passage O-ring

Description	Where Used	Part Number
Bellows Adhesive	Water passage O-ring and oil passage quad ring	92-86166Q1

3. Install driven gear and bearing assembly to outer propeller shaft.

4. Secure with snap ring.

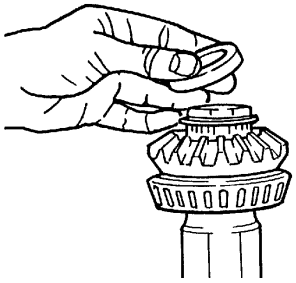


72213

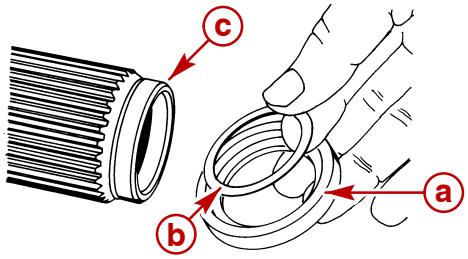
a - Driven gear and bearing assembly
b - Snap ring
c - Outer propeller shaft

NOTE: *The shim installed in the following step is used to regulate prop-shaft end-play. Use the existing shim as a starting point only if shafts, gears, or bearings were not replaced. If any of the components were replaced, use a .020 in. shim as a starting point. This shim may need to be adjusted if the end-play is not within specifications Refer to* ***Checking Propeller Shaft End-Play*** *later in this section).*

5. Install thrust cap and appropriate size shim on outer propeller shaft. Ensure that cap is straight while pressing into place.



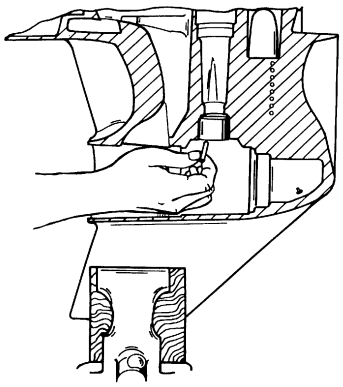
72212



71799

a - Thrust cap
b - Shim
c - Outer propeller shaft

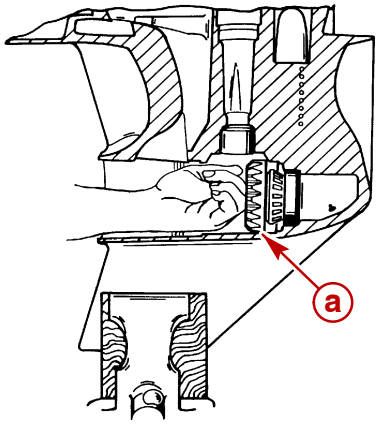
6. Ensure that all needle bearings are installed in drive shaft needle bearing case. Use lubricant to hold bearings in place.



72261

Description	Where Used	Part Number
Needle Bearing Assembly Lubricant	Needle bearings	92-802868A1

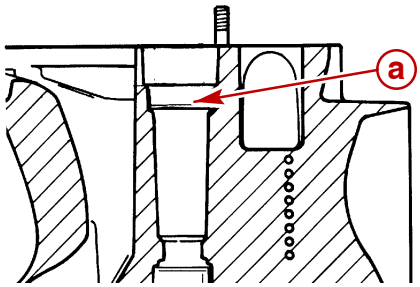
7. Install front driven gear assembly and original thickness shims into gear housing.



72249

a - Front driven gear assembly and shims

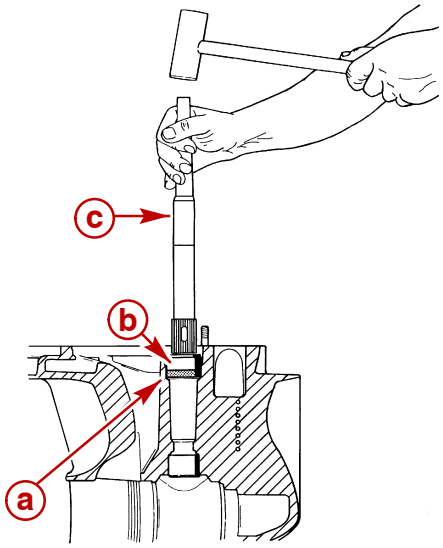
8. Install original thickness shims for lower bearing cup into gear housing. If shims were lost or ruined where original thickness cannot be determined, install a 0.050 in. (1.27 mm) shim pack for a starting point.



72262

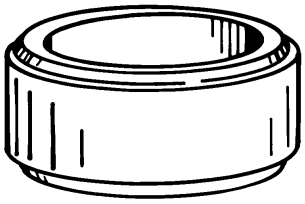
a - Shims

9. Install drive shaft lower bearing cup using Bearing Cup Driver.



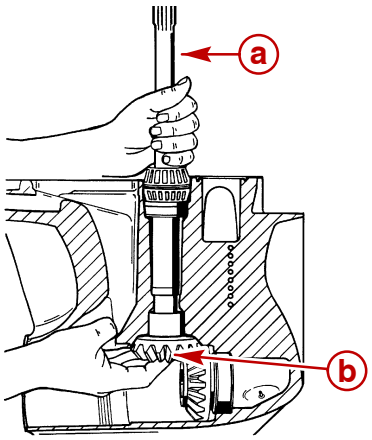
72263

a - Bearing cup
b - Bearing Cup Driver
c - Old propeller shaft or Puller Shaft

Bearing Cup Driver		
 73460	Installs the drive shaft bearing cup in the gear housing and bearing cup in the bearing carrier of the Bravo One and Bravo Two sterndrive units.	91-67443T

10. Install drive shaft and pinion gear into gear housing.

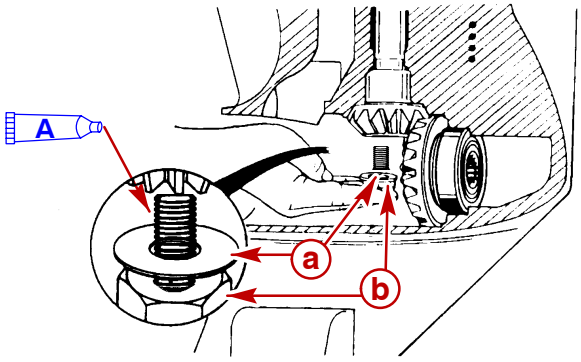
NOTE: *Be careful not to lose rollers from drive shaft pinion bearing should they drop during drive shaft installation.*



72264

a - Drive shaft
b - Drive shaft pinion gear

11. Install pinion washer and screw.
12. Apply sealant to threads of pinion screw.
13. Torque pinion screw.



76877

a - Washer
b - Screw

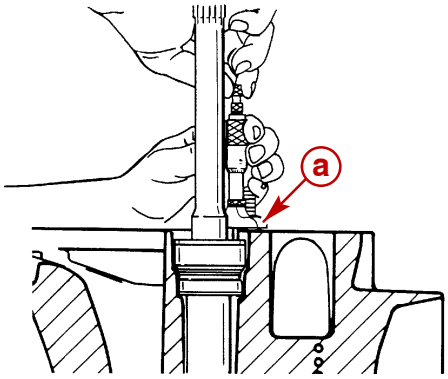
Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Threads of pinion screw	92-809819

Description	Nm	lb-in.	lb-ft
Pinion screw	61		45

14. Install upper bearing cup and tab washer.

15. Determine shim thickness required for drive shaft bearing preload.

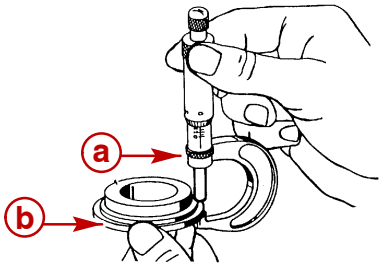
a. Measure distance between top of gear housing and tab washer using a 0-2.54 cm (0-1 in.) depth micrometer.



72452

a - 0-2.54 cm (0-1 in.) depth micrometer

b. Measure thickness of spacer from top machined surface to bottom machined surface using a 0-2.54 cm (0-1 in.) outside micrometer.



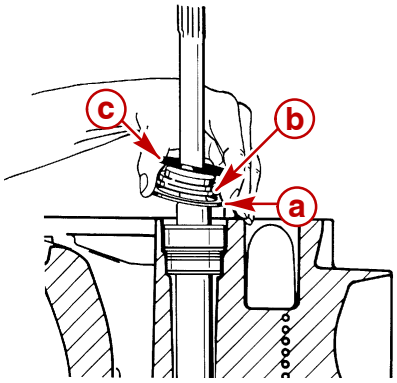
72523

a - 0-2.54 cm (0-1 in.) outside micrometer
b - Spacer

c. Calculate shim thickness as shown.

Measurement from Step “a”
–(Measurement from Step “b” + 0.025 mm [0.001 in.])
Shim Thickness Required.

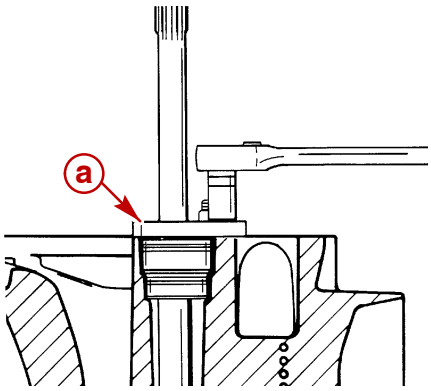
16. Install original thickness shims, spacer, and new O-ring.



72451

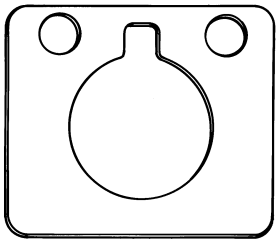
a - 0-2.54 cm (0-1 in.) shims
b - Spacer
c - O-ring

17. Reinstall Clamp Plate on gear housing with 4 nuts and washers. Tighten securely.

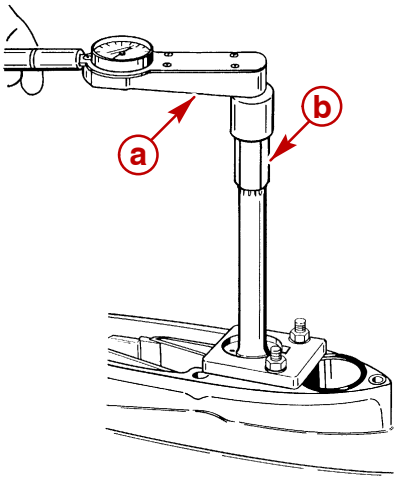


72266

a - Clamp Plate

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

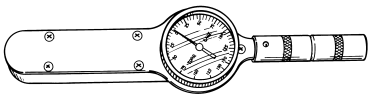
18. Using a dial-type lb-in. torque wrench, check the rolling preload by turning drive shaft with a slow steady motion. If necessary, add or subtract shims from beneath spacer to bring the preload into the specified range.

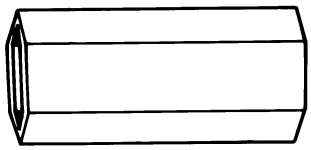


72269

a - Dial-type lb-in. Torque Wrench
b - Drive Shaft Adapter

Description	Nm	lb-in.	lb-ft
Rolling preload of drive shaft	0.3-0.6	3-5	

Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

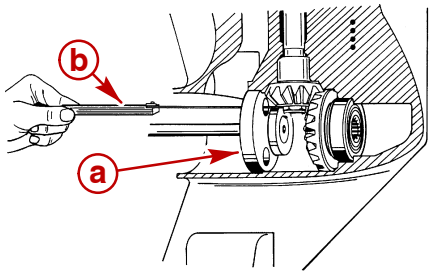
Drive Shaft Adapter		
 73427	Provides a wrench surface to turn the drive shaft only on all Bravo sterndrive units.	91-61077T

19. Ensure that Clamp Plate has been reinstalled after adjusting preload in the previous step. It must be in place for checking pinion height in the following procedure.

20. Check pinion height as follows:

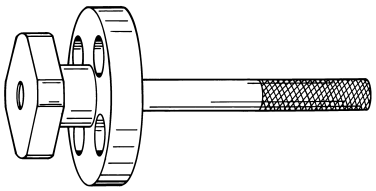
a. Insert Shimming Tool into gear housing.

b. Measure clearance between Shimming Tool and pinion gear with feeler gauge. Take measurement at 3 locations on pinion gear (120 degrees apart).



72268

a - Shimming Tool
b - Feeler gauge

Shimming Tool		
 73503	Measures the pinion height on the Bravo Three sterndrive units.	91-805462T

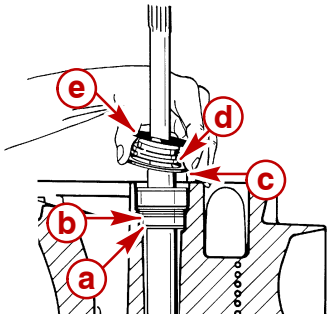
Description	mm	in.
Pinion gear clearance	0.635	0.025

c. If clearance is less than specified, add appropriate thickness of shims under lower tapered roller bearing cup.

NOTE: *Any thickness added here must be subtracted from shim thickness at upper bearing.*

d. If clearance is more than specified, remove appropriate thickness of shims from under lower tapered roller bearing cup.

NOTE: *Any thickness subtracted here must be added to shim thickness at upper bearing.*



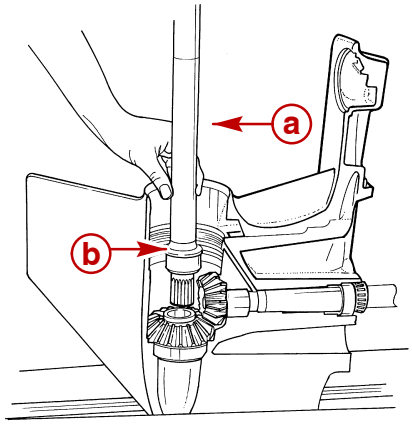
72451

a - Lower shims
b - Upper bearing cup
c - Upper shims
d - Spacer
e - O-ring

e. Recheck clearance after changing shims.

Checking Backlash

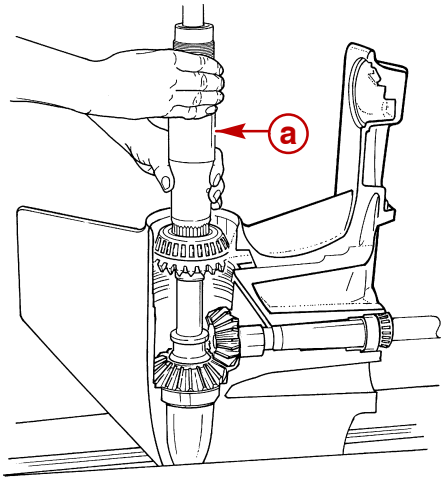
1. Install inner propeller shaft and thrust bearing into gear housing.



72270

a - Inner propeller shaft
b - Thrust bearing

2. Lubricate area between outer propeller shaft seal lips and install outer propeller shaft into gear housing.

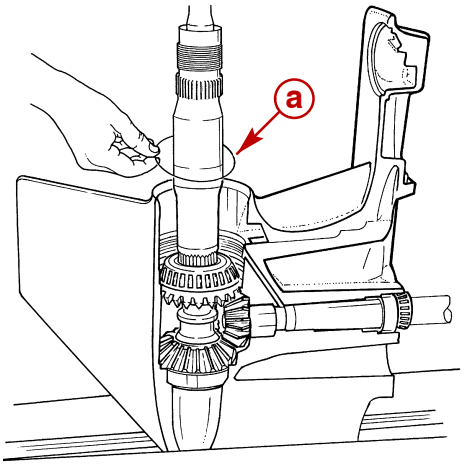


72271

a - Outer propeller shaft

Description	Where Used	Part Number
Special Lubricant 101	Area between outer propeller shaft seal lips	92-802865A1

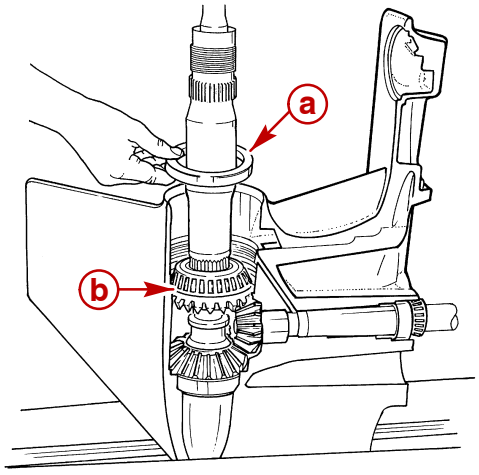
3. Install new shim pack into the gear housing of the same thickness as removed. If shims were lost or ruined where original thickness cannot be determined, install a 0.050 in. (1.3 mm) shim pack for a starting point.



72272

a - Shim pack

4. Install bearing cup into gear housing.
5. Seat bearing cup against shim pack.



72273

a - Bearing cup
b - Shim pack

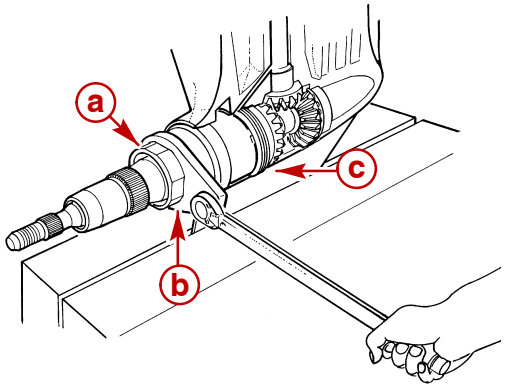
⚠ CAUTION

Outer propeller shaft bearing retainer has a LEFT HAND THREAD. Install by turning COUNTERCLOCKWISE.

IMPORTANT: Bearing carrier and threads on outer propeller shaft bearing retainer nut must be lubricated to prevent corrosion and cracking in gear housing.

6. Install outer propeller shaft bearing retainer nut by turning COUNTERCLOCKWISE and using outer propeller shaft bearing retainer installation tools.
7. Torque the retainer nut.

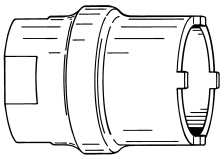
NOTE: *To ensure proper thread engagement, start retainer nut by hand. Turn retainer nut CLOCKWISE until thread engagement is felt, then turn COUNTERCLOCKWISE.*

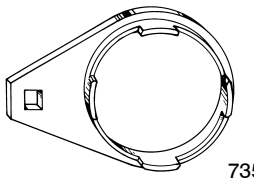


72274

a - Bearing Retainer Tool
b - Bearing Carrier Tool
c - Bearing retainer

Description	Nm	lb-in.	lb-ft
Outer propeller shaft bearing retainer nut	271		200

Bearing Retainer Tool		
 73515	Installs the bearing retainer on the Bravo Three sterndrive units.	91-805382T

Bearing Carrier Tool		
 73500	Use with 91-805382T Bearing Retaining Tool to remove propeller shaft retainer nut in the Bravo Three sterndrive units.	91-805374-1

8. Lubricate threads and O-ring surface area of bearing carrier and install O-ring on bearing carrier.
9. Fill area between seals with lubricant.

Description	Where Used	Part Number
Special Lubricant 101	Threads and O-ring surface area of bearing carrier and area between seals	92-802865A1

10. Apply sealant to tapered surface of bearing carrier.

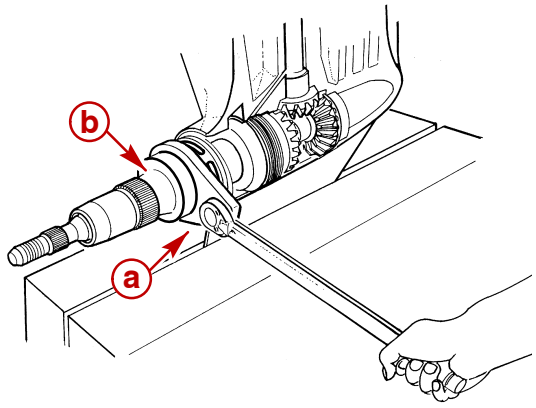
Description	Where Used	Part Number
Perfect Seal	Tapered surface of bearing carrier that comes in contact with housing	92-34227-1

⚠ CAUTION

Avoid damage to gear housing. Bearing carrier has a LEFT HAND THREAD. Install by turning COUNTERCLOCKWISE.

11. Install bearing carrier by turning COUNTERCLOCKWISE using Bearing Carrier Tool and torque.

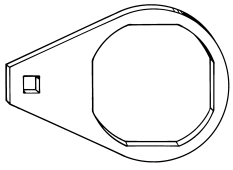
NOTE: *To ensure proper thread engagement, start retainer nut by hand. Turn retainer nut CLOCKWISE until thread engagement is felt then turn COUNTERCLOCKWISE.*



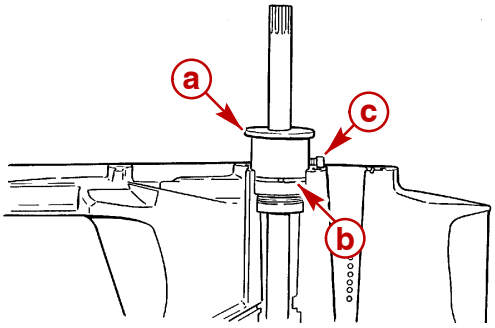
75895

a - Bearing Carrier Tool
b - Bearing carrier

Description	Nm	lb-in.	lb-ft
Bearing carrier	203		150

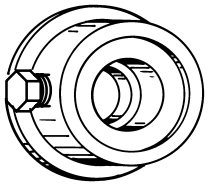
Bearing Carrier Tool		
 73495	Use with 91-805382T Bearing Retaining Tool to remove propeller shaft retainer nut in the Bravo Three sterndrive units.	91-805374

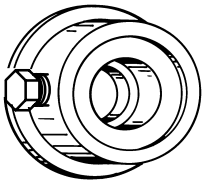
12. Shim front driven gear as follows:
    a. Remove clamp plate, O-ring, spacer, and shims.
    b. Place Drive Shaft Retaining Tool on tab washer. Do not tighten locking bolt at this time.
    c. Position gear housing so that propeller shafts are facing up in the vertical position. Rotate propeller shafts several times to seat bearings prior to making checks.
    d. Lightly press down on Drive Shaft Retaining Tool while simultaneously turning shaft. Rotate several times to ensure bearings are seated in bearing cups, then tighten locking bolt to retain drive shaft.



72623

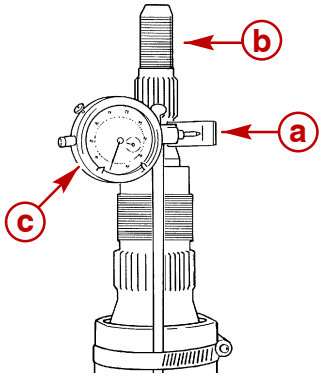
a - Drive Shaft Retaining Tool
b - Tab washer
c - Locking bolt

Drive Shaft Retaining Tool		
 78078	Holds bearings and the drive shaft in Bravo Three sterndrive units, Serial Number 0L999999 and Below, while checking backlash.	91-805381

Drive Shaft Retaining Tool		
 78078	Use to hold the bearings and the lower drive shaft while checking backlash on the Bravo Three sterndrive units.	91-863738

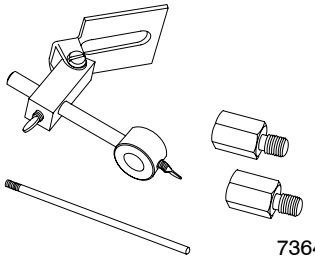
e. Install Backlash Indicator Rod to inner propeller shaft.

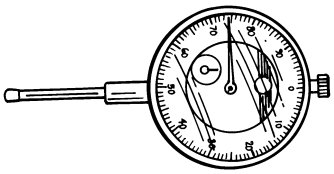
f. Mount Dial Indicator to bearing carrier and position probe on mark stamped in Backlash Indicator Rod.

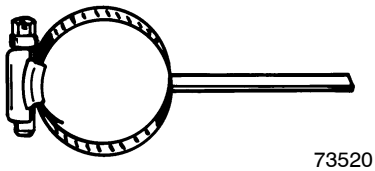


72908

a - Backlash Indicator Rod
b - Inner propeller shaft
c - Dial Indicator

Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-83155

Dial Indicator		
 73429	Measures the gear backlash on all the Bravo sterndrive units.	91-58222A1

Backlash Indicator Rod		
 73520	Indicates the inner propeller shaft backlash on the Bravo Three sterndrive units.	91-805481

g. Check total gear/spline backlash by lightly rotating inner propeller shaft back and forth. Observe Dial Indicator and record reading.

h. From the Gear/Spline Lash reading checked earlier, subtract reading obtained from Propeller Shaft Spline Lash Check.

Description	mm	in.
Gear backlash	0.3-0.4	0.012-0.016

Example:

Total Gear/Spline Backlash (Reading - Step 8g Above):	0.75 mm (0.030 in.)
Spline Lash (From Propeller Shaft - Spline Lash Check on page 3D-22):	0.4 mm (0.016 in.)
Actual Gear Backlash:	0.35 mm (0.014 In.)

i. If backlash is more than specified, add shims behind front driven gear bearing cup.

j. If backlash is less than specified, remove shims behind front driven gear bearing cup.

k. Recheck backlash reading after reassembly.

13. Shim rear driven gear as follows:

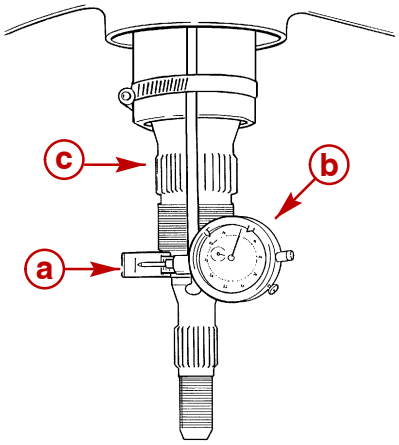
a. Position gear housing so that propeller shafts are facing down in the vertical position.

b. Loosen locking bolt on Drive Shaft Retaining Tool and rotate propeller shafts several times to seat bearings prior to making checks.

c. Lightly press down on Drive Shaft Retaining Tool to ensure bearings are seated in bearing cups, then tighten locking bolt to retain drive shaft.

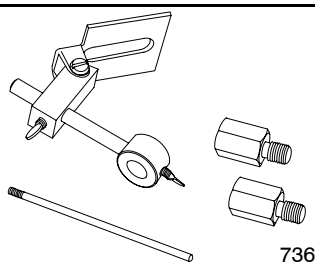
d. Install Backlash Indicator Rod to outer propeller shaft.

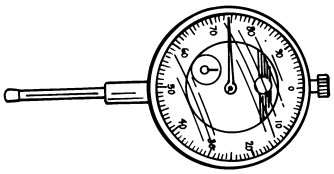
e. Mount Dial Indicator to bearing carrier and position probe on mark stamped in Backlash Indicator Rod.

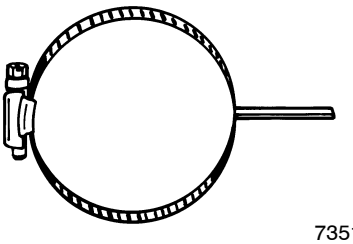


75907

a - Backlash Indicator Rod
b - Outer propeller shaft
c - Dial Indicator

Dial Indicator Adapter Kit		
 73643	Attaches a dial indicator to the gear case when checking backlash on the Bravo One, Bravo Two and Bravo Three sterndrive units.	91-83155

Dial Indicator		
 73429	Measures the gear backlash on all the Bravo sterndrive units.	91-58222A1

Backlash Indicator Rod		
 73517	Indicates the outer propeller shaft backlash on the Bravo Three sterndrive units.	91-805482

f. Check gear/spline lash by lightly rotating outer propeller shaft back and forth. Observe Dial Indicator and record reading.

g. From the gear/spline lash reading checked earlier, subtract reading obtained from **Propeller Shaft Spline Lash Check**.

Description	mm	in.
Propeller Shaft End Play	0.025-0.030	0.001-0.012

Example:

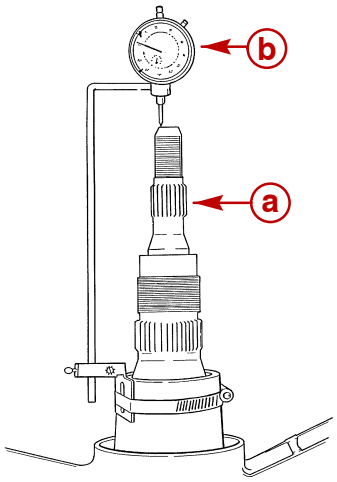
Total Gear/Spline Backlash Reading:	0.75 mm (0.030 In.)
Spline Lash (From Propeller Shaft - Spline Lash Check):	- 0.4 mm (0.016 in.)
Actual Gear Backlash:	0.35 mm (0.014 in.)

h. If backlash is more than specified, remove shims in front of rear driven gear bearing cup.

i. If backlash is less than specified, add shims in front of rear driven gear bearing cup.

j. Recheck backlash reading after reassembly.

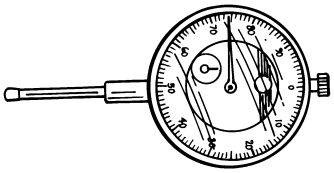
14. Check prop shaft end play.
15. Install Dial Indicator on prop shaft.
16. Move inner shaft up and down while reading Dial Indicator (ensure outer shaft is also being lifted by inner shaft). End play reading should be between must be within the acceptable range. If reading is outside of range, the outer propeller shaft thrust race shims must be increased or decreased to bring the end play reading within this range.



75909

a - Inner propeller shaft
b - Dial Indicator

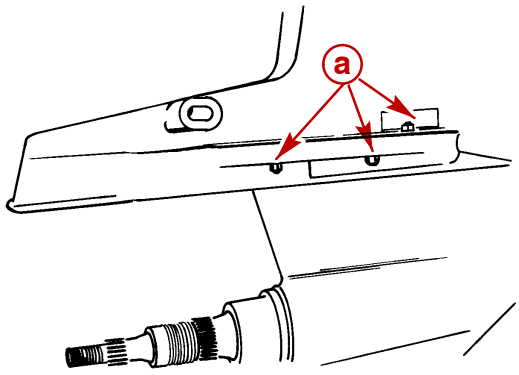
Description	
Acceptable end play reading	0.025-0.30 mm (0.001-0.012 in.)

Dial Indicator		
 73429	Measures the gear backlash on all the Bravo sterndrive units.	91-58222A1

17. Remove Drive Shaft Retaining Tool and reinstall shims, spacer, and O-ring.

Installing Gear Housing On Drive Shaft Housing

1. Install gear housing to drive shaft housing as follows:
   a. Lower upper drive shaft housing down onto gear housing and install 6 locknuts and washers.
   b. Torque locknuts.

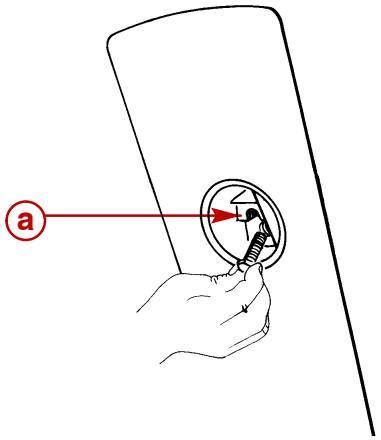


76803

a - Locknuts and washers (6)

Description	Nm	lb-in.	lb-ft
Upper drive shaft to gear housing locknuts	47		35

   c. Install bolt in anode cavity and torque.



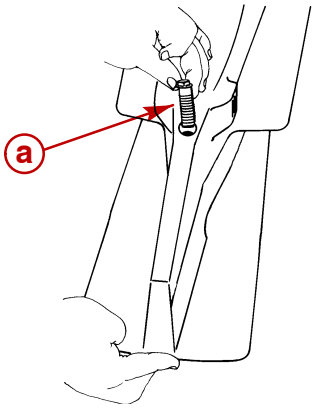
76804

a - Bolt

Description	Nm	lb-in.	lb-ft
Anode cavity bolt	47		35

d. Install anode and torque.

e. Install rubber plug.



76832

a - Bolt

Description	Nm	lb-in.	lb-ft
Anode bolt	27		20

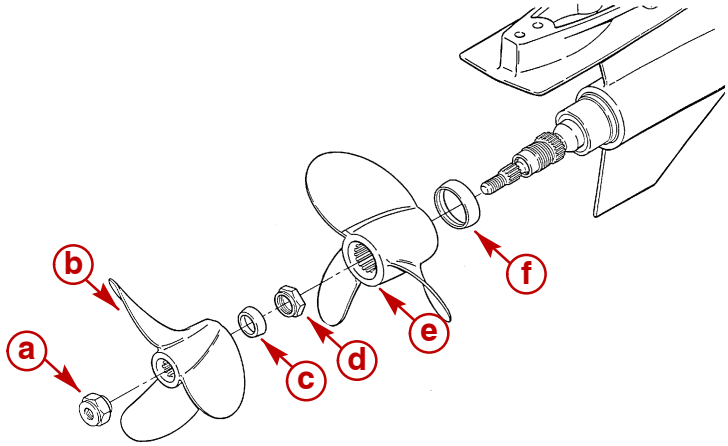
2. Reinstall sterndrive unit. Refer to **Section 2A - Removal, Installation, and Adjustments**.
3. Fill sterndrive unit with lubricant. Refer to **Section 1B - Maintenance**.

Propeller Installation

⚠ WARNING

Check propeller tightness after 20 hours of operation. Do not operate the boat with a loose propeller.

1. Apply a liberal coat of 1 of the following lubricants to both the inner and outer propeller shafts.



75899

a - Rear propeller nut
b - Rear propeller
c - Rear propeller thrust hub
d - Front propeller nut
e - Front propeller
f - Front propeller thrust hub

Description	Where Used	Part Number
Special Lubricant 101	Inner and outer propeller shafts	92-802865A1
2-4-C with Teflon	Inner and outer propeller shafts	92-802859A1
Anti-Corrosion Grease	Inner and outer propeller shafts	92-802867A1

2. Slide the front thrust hub onto the outer propeller shaft with the tapered side of the hub toward the aft end of the propeller shaft.
3. Align the splines and place the forward propeller onto the outer propeller shaft.
4. Install the front propeller nut and torque.

Description	Nm	lb-in.	lb-ft
Front propeller nut	136		100

5. Slide the rear thrust hub onto the inner propeller shaft with the tapered side of the hub toward the aft end of the propeller shaft.
6. Align the splines and place the rear propeller onto the inner propeller shaft.
7. Install the rear propeller nut and torque.

Description	Nm	lb-in.	lb-ft
Rear propeller nut	81		60

TRANSOM ASSEMBLY

Section 4A - Service Procedures Requiring Minor Disassembly

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4 A

Bravo Transom Assembly Specifications

Torque Specifications

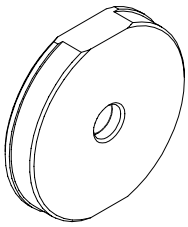
NOTE: *Securely tighten all fasteners not listed below.*

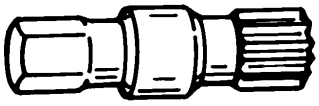
Description	Nm	lb-in.	lb-ft
Shift cable core wire anchor screws	2.3	20	
Exhaust bellows hose clamps	4	35	
Hinge pins	203		150
Flanged nut	7	65	
Trim wire retainer screw	11	95	

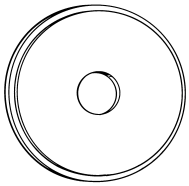
Lubricants / Sealants / Adhesives

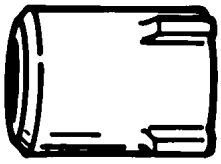
Description	Where Used	Part Number
Bellows Adhesive	U-joint bellows	92-86166Q1
	Exhaust bellows	
	Bell housing side gear lube valve O-ring	
	Shift cable bellows	
	Mounting surfaces on inside of bellows	
2-4-C with Teflon	Threads of tapered insert	92-802859A1
	Gimbal ring clamp screw	
Perfect Seal	Flanged nut threads	92-34227-1
	Bayonet fitting	
	Water bypass plug	
Loctite 271 Threadlocker	Bell housing threads	92-809819
	Studs	
	Swivel shaft seal	
	Hinge pin washer inner surface	
High Performance Gear Lube	Gear lube valve O-rings	92-802854A1
Sealer Kit, Two Part Epoxy	Bushings	92-65150-1
U-Joint and Gimbal Bearing Grease	Gimbal bearing	92-802870A1
Super Glue	Gimbal housing seal	Obtain locally
	Exhaust passage seal	
Soapy water or engine cleaner	Sleeve outside diameter	Obtain locally
Special Lubricant 101	Hinge pin	92-802865Q 1
Loctite 242 Threadlocker	Threads Of Screw	Obtain locally
Lacquer Thinner	Exhaust Mounting Bellows	Obtain locally

Special Tools

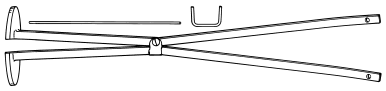
Retention Sleeve Removal Tool		
 78063	Use to remove the U-joint bellows retention sleeve on all the Bravo 2000 transom assemblies. Used also to remove the aluminum sleeve from the U-joint bellows of all Bravo sterndrive units, Serial Number 0L99999 and below.	91-862546

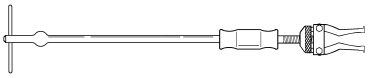
Hinge Pin Tool		
 73443	Installs and removes the hinge pins from most all Mercury MerCruiser Transom units.	91-78310

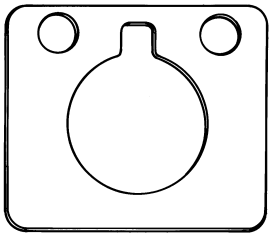
Sleeve Installation Tool		
 73485	Installs the aluminum sleeve in the U-joint bellows of all the Bravo sterndrive units.	91-818162

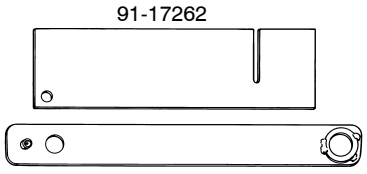
Tapered Insert Tool		
 73456	Installs and removes the tapered insert retainer into the water inlet hose on all the Bravo transom units.	91-43579

Special Tools (continued)

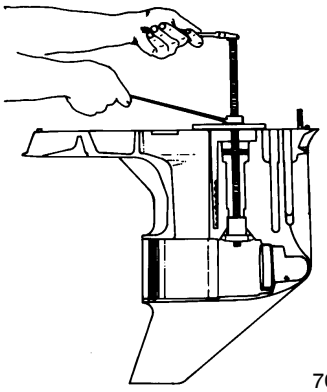
Bellows Expander Tool		
 73430	Installs the exhaust bellows on the Bravo One, Bravo Two, and Bravo Three Transom units.	91-45497A1

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

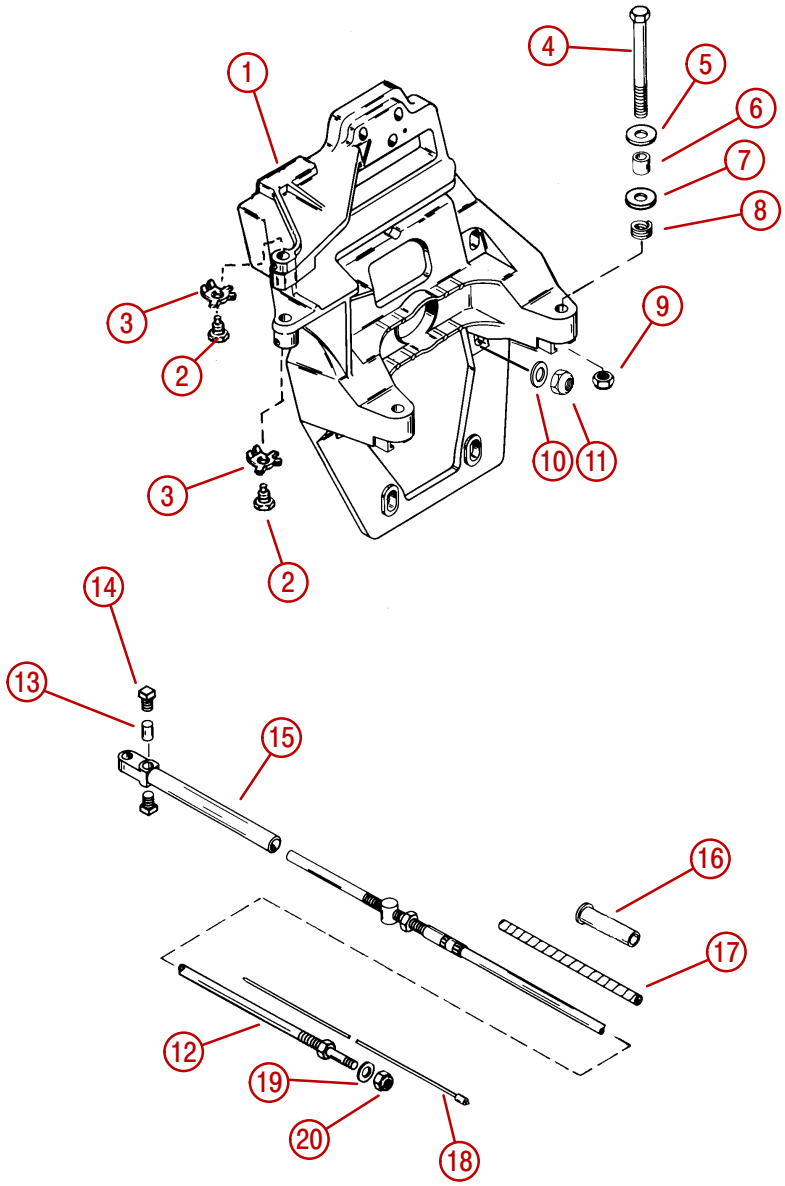
Shift Cable Anchor Adjustment Tool		
 73478	Used when installing a new Shift Cable Core wire in all Bravo Transoms. 91-17263 Core Wire Locating Tool 91-17262 Shift Cable Anchor Adjustment Tool	91-17262A1

Special Tools (continued)

Bearing Removal and Installation Tool Assembly		
 70615	Installs and removes the bearings on all Alpha and Bravo sterndrive gear cases. 91-31229A7 tool assembly includes the following components: 11-24156 Hex Nut 91-15755T Bearing Carrier 91-29310 Plate 91-29610 Pilot Plate 91-30366T1 Mandrel 91-31229 Puller Shaft 91-32325T Driver Head 91-32336 Driver Needle Bearing 12-34961 Washer 91-36379 Puller / Head Gear 91-36569T Driver Head 91-36571T Pilot Washer 91-37292 Roller Bearing 91-37311 Driver Head 91-37312 Driver Head 91-37323 Driver Head Rod 91-37324 Pilot Washer 91-38628T Puller / Driver Head 91-52393 Driver Needle Bearing 91-52394 Head Pull Rod	91-31229A7

Bravo Transom Assembly Exploded Views

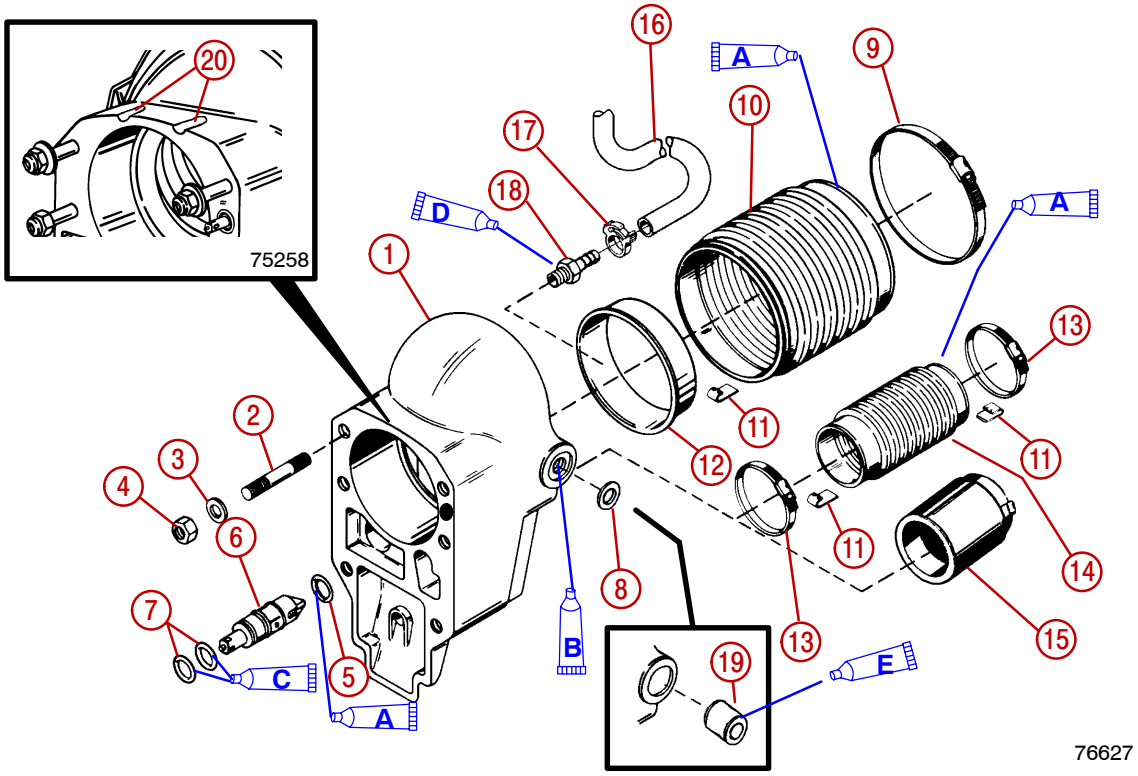
Inner Transom Plate Components



76857

1 - Transom plate assembly
2 - Pivot bolts
3 - Tab washers
4 - Rear engine mounting bolt
5 - Washer
6 - Spacer
7 - Washer - fiber
8 - Lockwasher - double wound
9 - Locknut
10 - Washer
11 - Locknut
12 - Shift cable casing
13 - Core wire anchor
14 - Set screws (2)
15 - End guide
16 - Nylon tube
17 - Nylon wrapping
18 - Core wire
19 - Sealing washer
20 - Nut

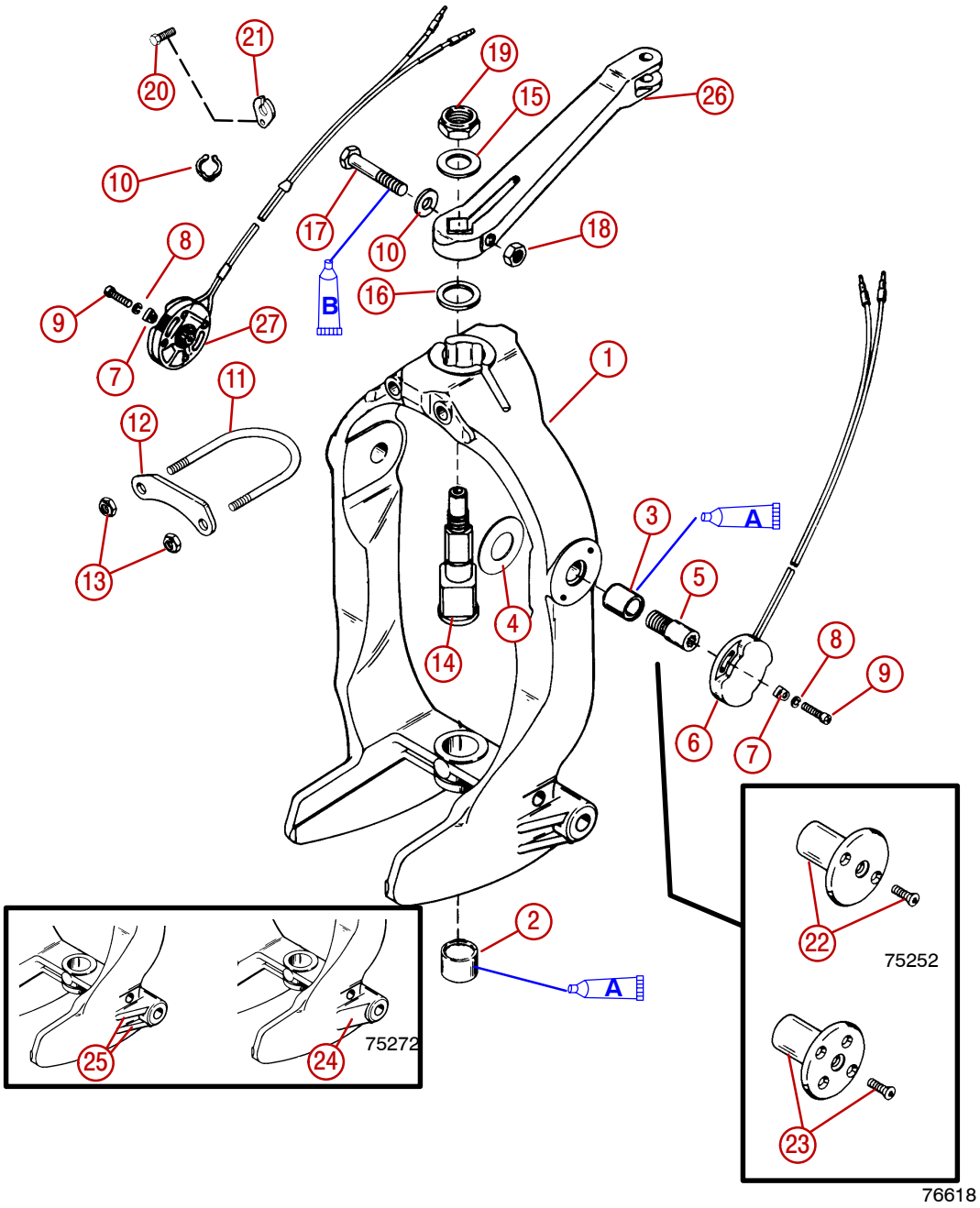
Bell Housing Components



1 - Bell housing
2 - Stud
3 - Washer
4 - Locknut
5 - O-ring
6 - Gear lube valve
7 - O-rings
8 - Hinge pin washer
9 - Bellows clamp
10 - U-joint bellows
11 - Grounding clip
12 - Sleeve
13 - Bellows clamp
14 - Exhaust bellows
15 - Exhaust tube (some models)
16 - Lube monitor hose
17 - Hose clamp
18 - Bayonet fitting
19 - Bushing (High Performance transom)
20 - Indentations in bell housing

Description		Where Used	Part Number
A	Bellows Adhesive	U-joint bellows	92-86166Q1
		Exhaust bellows	
		Bell housing side gear lube valve O-ring	
B	Loctite 271 Threadlocker	HIng pin washer inner surface	92-809819
C	High Performance Gear Lube	Gear lube valve O-rings	92-802854A1
D	Perfect Seal	Bayonet fitting	92-34227-1
E	Sealer Kit, Two Part Epoxy	Bushing	92-65150-1

Gimbal Ring Components

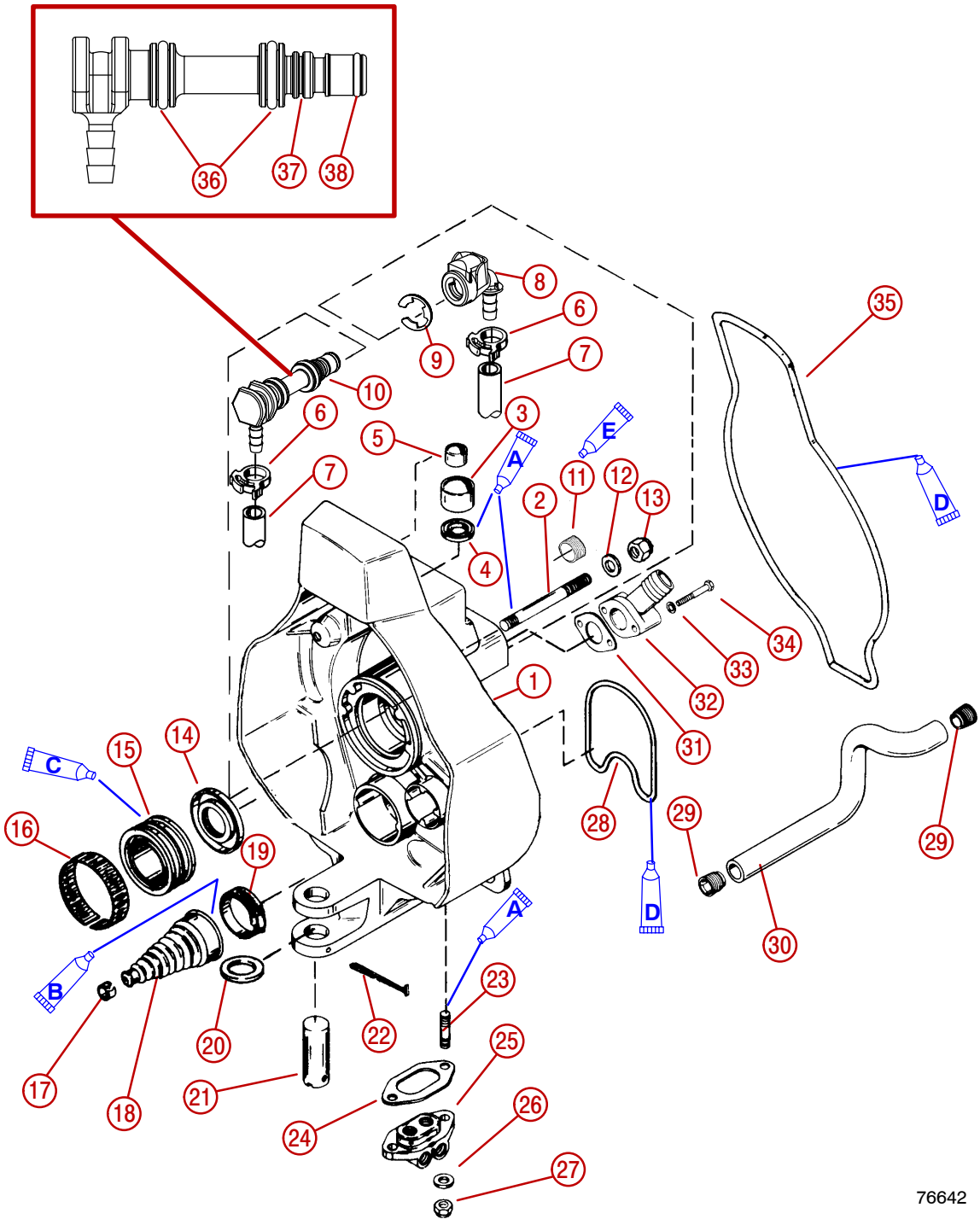


Gimbal Ring Components (continued)

1 - Gimbal ring
2 - Bushing
3 - Bushing
4 - Flat washer
5 - Hinge pin
6 - Trim position sender
7 - Flat washer
8 - Lockwasher
9 - Screw
10 - Clip
11 - U-Bolt
12 - Plate
13 - Locknuts
14 - Swivel shaft
15 - Flat washer (smaller ID)
16 - Flat washer (larger ID)
17 - Clamp screw
18 - Locknut
19 - Nut
20 - Screw
21 - Clamp plate
22 - High Performance hinge pin assembly (early style) (2 screws)
23 - High Performance hinge pin assembly (later style) (4 screws)
24 - Magnum and High Performance gimbal ring identification (filled area)
25 - Standard gimbal ring identification (2 ribs)
26 - Steering lever
27 - Trim limit switch

Description		Where Used	Part Number
A	Sealer Kit, Two Part Epoxy	Bushings	92-65150-1
B	2-4-C with Teflon	Gimbal ring clamp screw	92-802859A1

Gimbal Housing Components



Gimbal Housing Components (continued)

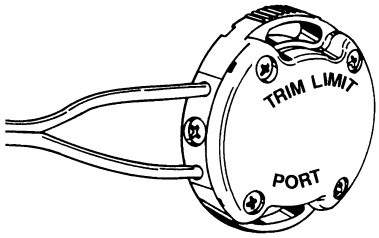
1 - Gimbal housing
2 - Stud
3 - Swivel shaft bushing (lower)
4 - Swivel shaft seal
5 - Swivel shaft bushing (upper)
6 - Clamp
7 - Lube monitor hose
8 - Quick disconnect fitting
9 - E-Clip
10 - Gear lube fitting
11 - Water bypass plug
12 - Flat washer
13 - Locknut
14 - Seal
15 - Gimbal bearing
16 - Tolerance ring
17 - Crimp clamp
18 - Shift cable bellows
19 - Bellows clamp
20 - Washer
21 - Lower swivel pin
22 - Cotter pin
23 - Stud
24 - Gasket
25 - Hydraulic manifold
26 - Washer
27 - Locknut
28 - Exhaust passage seal
29 - Water hose insert
30 - Water hose
31 - Water fitting gasket
32 - Water fitting
33 - Lockwasher
34 - Screw
35 - Gimbal housing seal
36 - Large O-rings
37 - Snap ring groove
38 - Small O-ring

Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Studs	92-809819
		Swivel shaft seal	
B	Bellows Adhesive	Shift cable bellows	92-86166Q1
C	U-joint and Gimbal Bearing Grease	Gimbal bearing	92-802870A1
D	Super Glue	Gimbal housing seal	Obtain locally
		Exhaust passage seal	
E	Perfect Seal	Water bypass plug	92-34227-1

Special Information

Trim Limit Switch

The trim limit switch has a sealing system for improved water resistance and durability. The trim limit switch leads are connected internally to help ensure good electrical integrity.

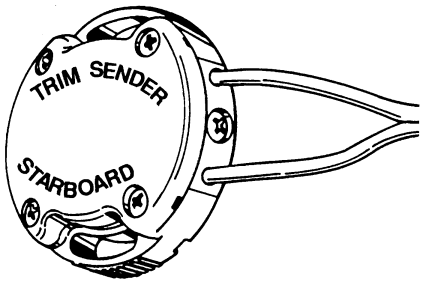


71415

Trim limit switch - port

Trim Position Sender

The trim position sender has a sealing system for improved water resistance and durability. The trim limit leads are connected internally to help ensure good electrical integrity.



71414

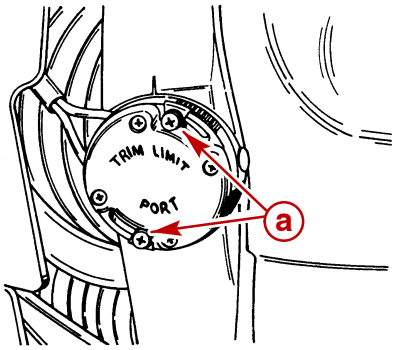
Trim position sender - starboard

Removal

⚠ WARNING

Disconnect both battery cables before installing new trim limit switch or trim sender.

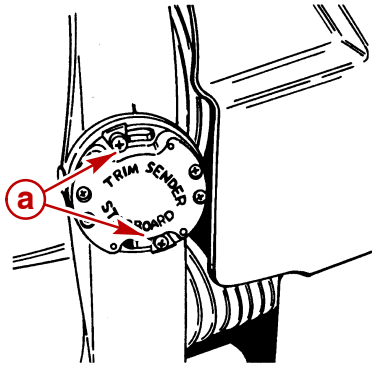
1. Remove sterndrive unit. Refer to **Section 2A**.
2. Remove trim limit switch.



71221

a - Attaching hardware

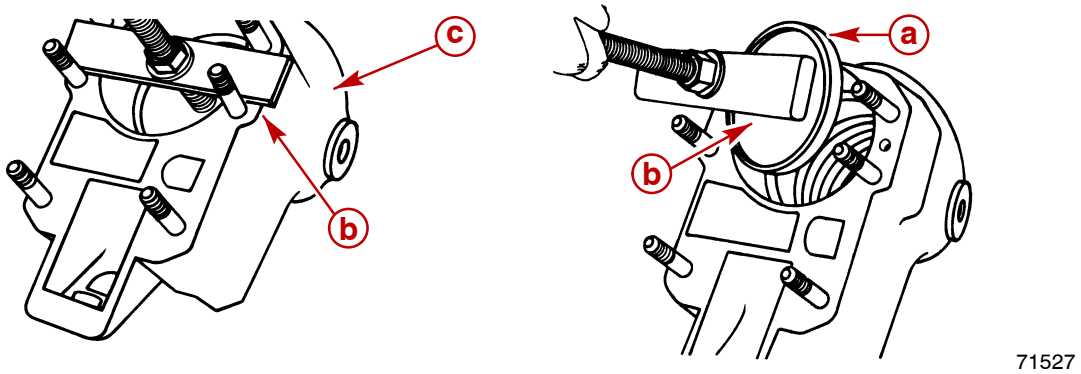
3. Remove trim position sender.



71220

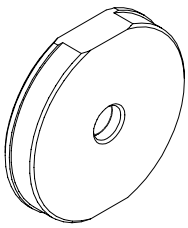
a - Attaching hardware

4. Spray engine cleaner around edge of bellows sleeve and remove with Retention Sleeve Removal Tool.

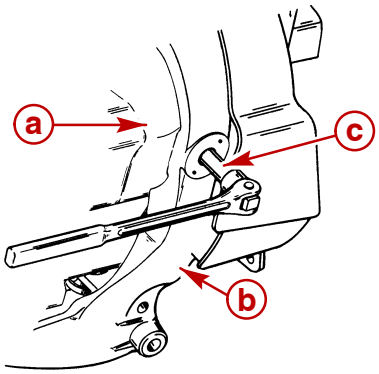


71527

a - Sleeve
b - Retention Sleeve Removal Tool
c - Bell housing

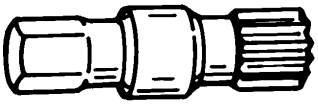
Retention Sleeve Removal Tool		
 78063	Use to remove the U-joint bellows retention sleeve on all the Bravo 2000 transom assemblies. Used also to remove the aluminum sleeve from the U-joint bellows of all Bravo sterndrive units, Serial Number 0L99999 and below.	91-862546

5. Remove starboard and port hinge pins.
   a. Using the Hinge Pin Tool, loosen and remove hinge pin.

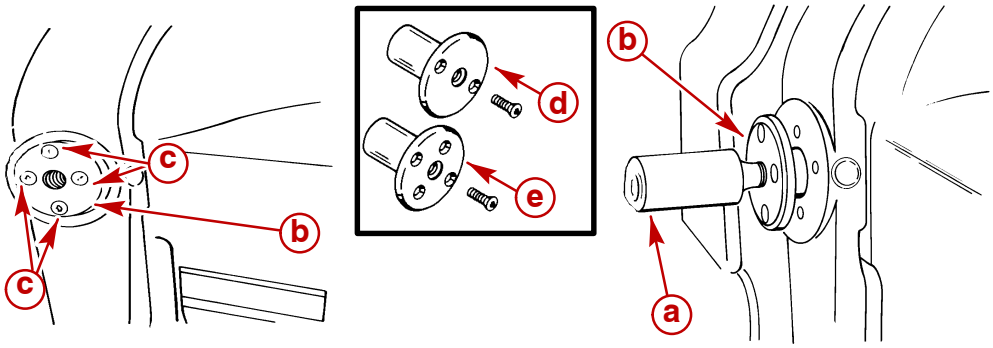


22113

a - Bell housing
b - Gimbal ring
c - Hinge Pin Tool

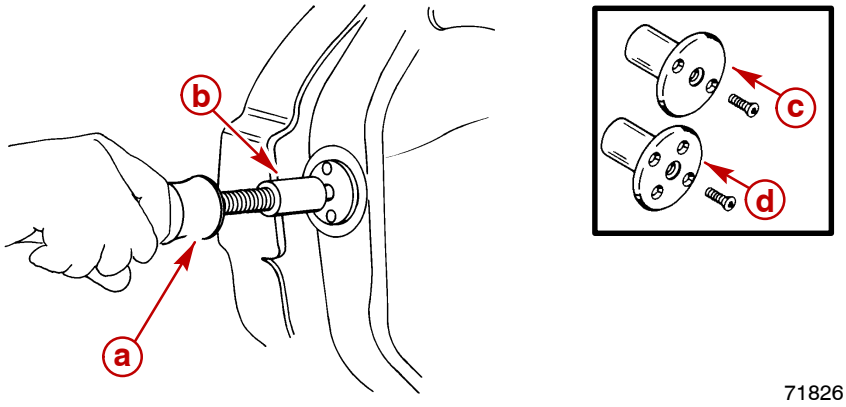
Hinge Pin Tool		
 73443	Installs and removes the hinge pins from Mercury MerCruiser gimbal ring and bell housing assemblies.	91-78310

6. **High Performance Transom Assembly:** Remove hinge pins using Puller Head and Slide Hammer.
   a. Remove torx screws and thread Puller Head into the hinge pin.



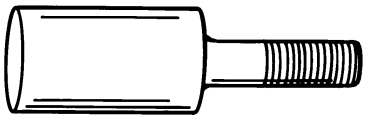
a - Puller Head
b - Hinge pin
c - Screw holes
d - High performance hinge pin early style (2 screws)
e - High performance hinge pin later style (4 screws)

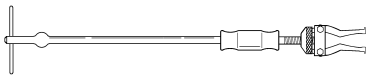
b. Remove hinge pin by using the Slide Hammer Puller.



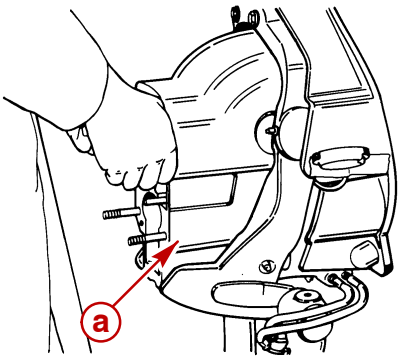
71826

a - Slide Hammer Puller
b - Puller Head
c - High Performance hinge pin early style (2 screws)
d - High Performance hinge pin later style (4 screws)

Puller Head		
 73428	Removes hinge pin from the Bravo One, Bravo Two and Bravo Three High Performance sterndrive units.	91-63616T

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

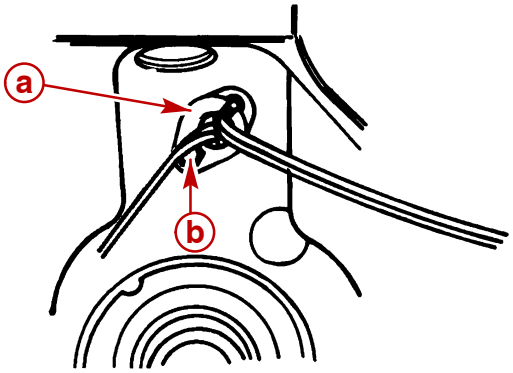
7. Pull back on bell housing and rotate it 90 degrees to gain access to the trim wire clamp plate screw.



23363

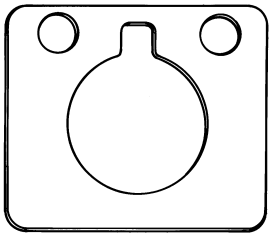
a - Bell housing

8. Remove trim wire clamp plate.



70197

a - Clamp Plate
b - Screw

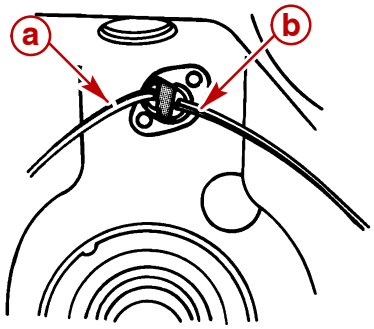
Clamp Plate		
 73433	Holds a preload while checking the backlash and bearing preload on all Mercury MerCruiser Bravo sterndrive units.	91-43559T

9. Unplug trim position sender wires from engine harness.
10. Unplug trim limit switch wires from trim pump.

Installation

NOTE: *Old harness may be used to pilot new harnesses through hole in gimbal housing.*

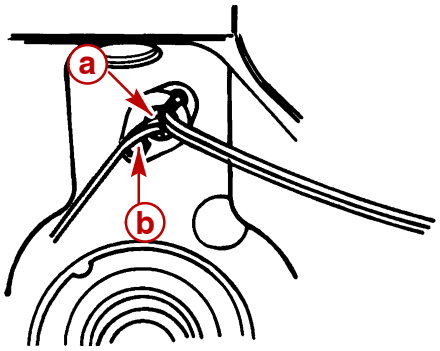
1. Route new sender wires through hole.
2. Bring together the two grommet halves and ensure that they are seated lightly in the hole with the flat mating edges vertically aligned.
3. Maintain light tension on the wires from inside the boat to hold the grommets in the hole.



70198

a - Trim limit switch wires
b - Trim position sender wires

4. Reinstall retainer and torque screw.



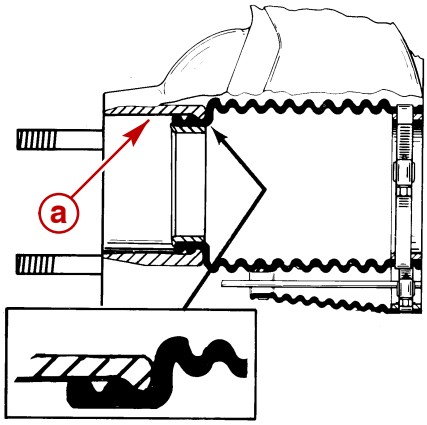
70197

a - Clamp
b - Screw

Description	Nm	lb-in.	lb-ft
Shift cable core wire retainer screw	11	95	

5. Install U-joint bellows on bell housing as follows:

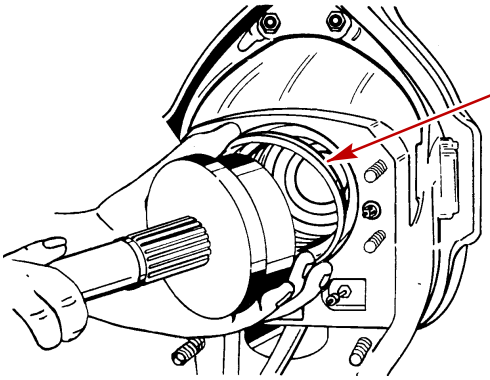
   a. Position U-joint bellows on bell housing. Ensure that the bell housing flange rests in the second groove from the end of the bellows.



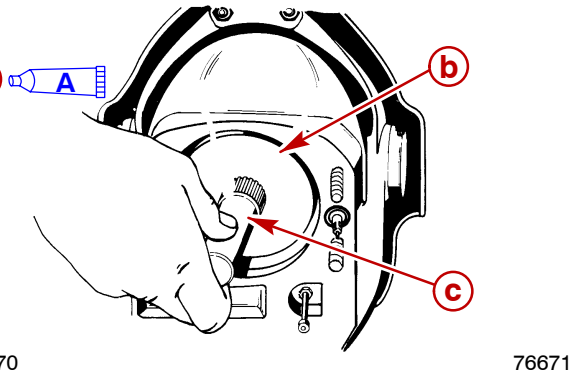
22116

a - Bell housing flange

   b. Lubricate sleeve outside diameter. Install sleeve with Sleeve Installation Tool and a suitable driving rod.



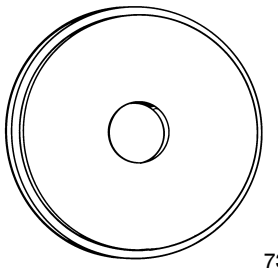
76670



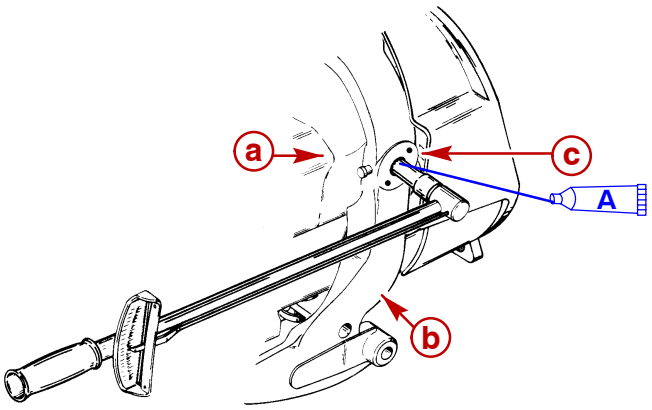
76671

a - Sleeve
b - Sleeve Installation Tool
c - Suitable driving rod

Description		Where Used	Part Number
A	Soapy water or engine cleaner	Sleeve outside diameter	Obtain locally

Sleeve Installation Tool		
 73485	Installs the aluminum sleeve in the U-joint bellows of all the Bravo transom units.	91-818162

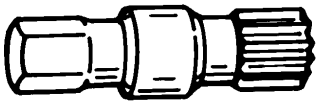
6. Apply sealant to bell housing threads and install port and starboard hinge pins.
7. Torque hinge pins.



76619

a - Bell housing
b - Gimbal ring
c - Hinge Pin Tool

Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Bell housing threads	92-809819

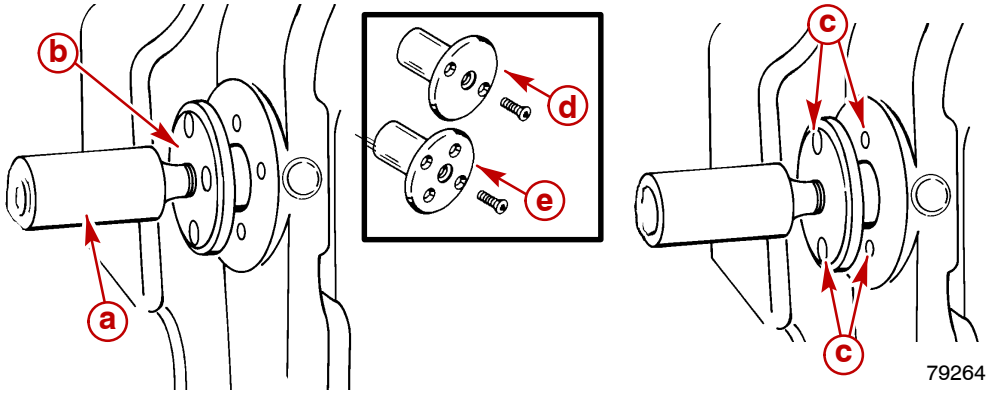
Hinge Pin Tool		
 73443	Installs and removes the hinge pins from Mercury MerCruiser gimbal ring and bell housing assemblies.	91-78310

Description	Nm	lb-in.	lb-ft
Hinge pins	203		150

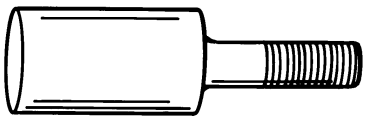
8. **High Performance Models**: Install port and starboard hinge pins using Puller Head and Slide Hammer.
   a. Thread Puller Head into hinge pin.
   b. Lubricate hinge pin.

Description	Where Used	Part Number
Special Lubricant 101	Hinge pin	92-802865Q 1

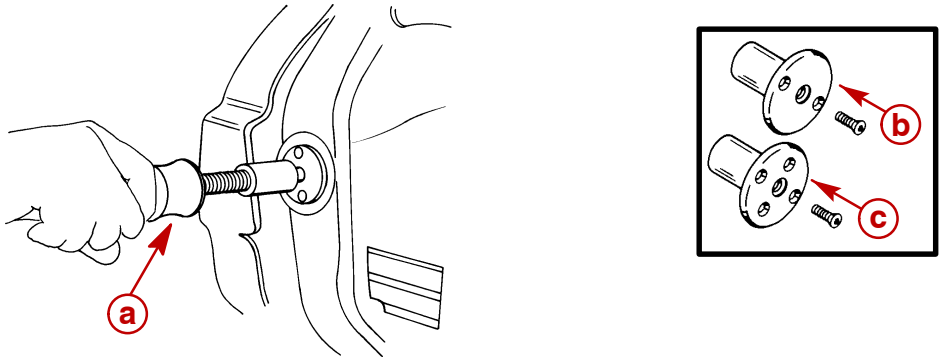
   c. Slide hinge pin through gimbal ring and bell housing.
   d. Align the screw holes in hinge pin with the screw holes in gimbal ring.



a - Puller Head
b - Hinge pin
c - Screw holes
d - High Performance hinge pin early style (2 screws)
e - High Performance hinge pin later style (4 screws)

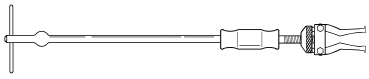
Puller Head		
 73428	Removes hinge pin from the Bravo One, Bravo Two and Bravo Three High Performance sterndrive units.	91-63616T

9. Lightly tap hinge pin into place using Slide Hammer.



71826

a - Slide Hammer
b - High Performance hinge pin early style (2 screws)
c - High Performance hinge pin later style (4 screws)

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

10. Apply sealant to threads of screws.
11. Install and torque.

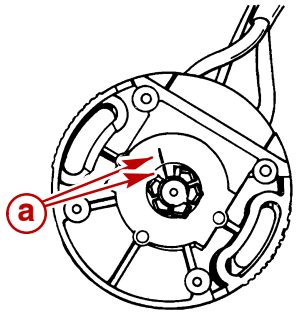
Description	Where Used	Part Number
Loctite 242 Threadlocker	Threads Of Screw	Obtain locally

Description	Nm	lb-in.	lb-ft
High performance hinge pin screws (2) early style	203		150
High performance hinge pin screws (4) later style	3	27	

Trim Position Sender and Switch Installation

NOTE: *496 cid (8.1 liter) models require a different procedure for adjustment This procedure is not available at time of publication.*

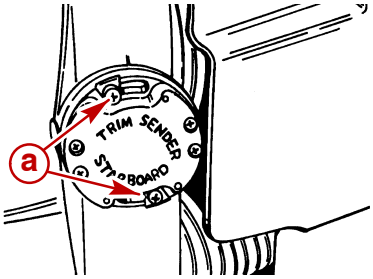
1. Place sterndrive unit in the full DOWN/IN position.
2. Turn center rotor of trim limit switch to align index mark with index mark on sender body.



71218

a - Index marks

3. Install trim position sender and secure with attaching hardware.

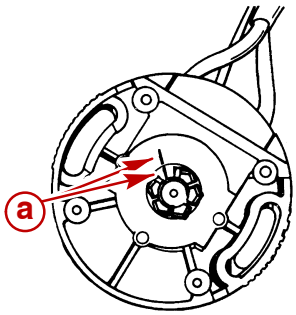


71220

a - Attaching hardware

4. Place sterndrive unit in full DOWN/IN position.

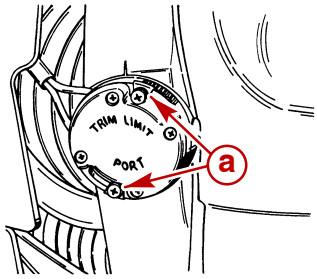
5. Turn center rotor of trim position sender to align index mark with index mark on sender body.



71218

a - Index marks

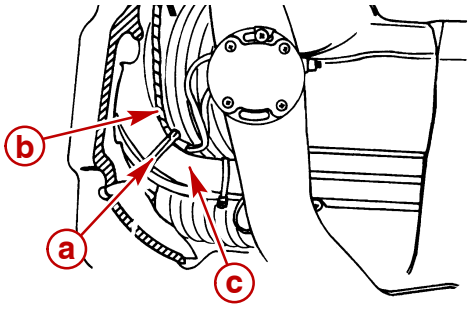
6. Install trim limit switch and secure with attaching hardware.



71221

a - Attaching hardware

7. Secure the trim limit switch harness to the water hose with the plastic clip.



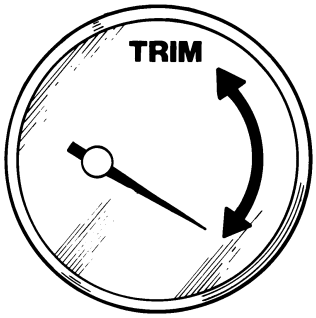
71184

a - Plastic clip
b - Trim limit switch harness
c - Water hose

8. Reconnect trim position sender wires to engine harness and the trim limit leads to trim pump harness.
9. Reinstall battery cables.

TRIM POSITION SENDER ADJUSTMENT

1. Turn ignition key to the RUN position. Do not start engine.
2. Rotate trim position sender until needle is at bottom of arc on gauge.



22175

3. Tighten trim position sender retaining screws and recheck gauge.

TRIM LIMIT SWITCH ADJUSTMENT

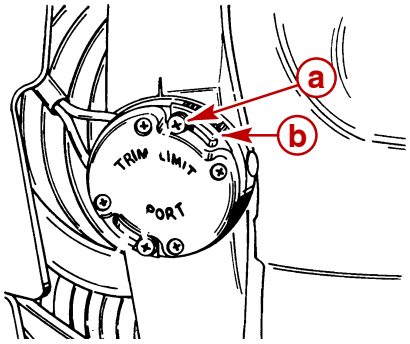
⚠ WARNING

When adjusting trim limit switch, use extreme care that engine is not started and keep clear of area near propeller. Use care to prevent placing hands in an area where injury could occur because of sterndrive unit movement.

⚠ CAUTION

Trim limit switch must be adjusted exactly as outlined. If switch is adjusted incorrectly, sterndrive unit could move out beyond the gimbal ring support flanges and cause damage to sterndrive unit.

1. Loosen screws and turn trim limit switch CLOCKWISE to end of slots.

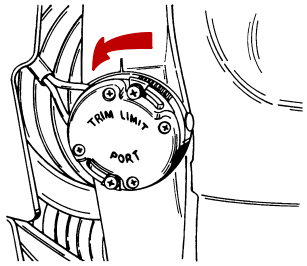


71221

a - Screws
b - Slots

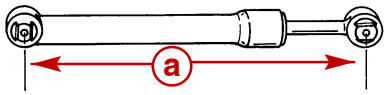
2. Ensure that sterndrive unit is in the full DOWN/IN position.
3. Trim sterndrive unit UP/OUT. Do not use trailer switch.

4. Slowly turn trim limit switch COUNTERCLOCKWISE until trim cylinders extend to correct dimension.



71221

5. Retighten screws when adjustment is correct.



50464

a - Trim limit dimension

Description	
Trim limit dimension	552 mm (21-3/4 in.)

High Performance Transom Assembly - Without Electrical Trim Sender and Trim Limit Switch

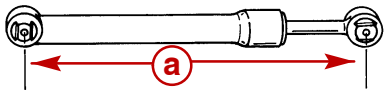
IMPORTANT: The electrical trim limit switch and trim position sender are not present on this transom assembly. Without a trim limit switch, the sterndrive unit can be trimmed UP/OUT beyond the position where the sterndrive unit has side support from the gimbal ring at any throttle setting. It is highly recommended that a mechanical (cable actuated) trim position indicator be installed to provide important sterndrive unit trim angle information to the operator and that the trim indicator be marked to clearly indicate the maximum UP/OUT position where side support is still provided. The sterndrive unit should not be trimmed to a position beyond gimbal ring side support at engine speeds above 1200 rpm.

⚠ WARNING

Avoid personal injury or damage to sterndrive unit. Do not trim sterndrive unit to an UP/OUT position where the sterndrive unit receives no side support from the gimbal ring at engine speeds above 1200 rpm. Refer to a properly marked mechanical trim position indicator.

1. Install WARNING DECAL (contained in the transom assembly box) at the operator station in a place where it will be clearly visible to the operator.
2. To mark the maximum trim UP/OUT position on the mechanical trim indicator, proceed as follows:
   a. Trim sterndrive units to the FULL DOWN/IN position.
   b. Ensure that the mechanical trim indicator indicates FULL DOWN/IN position. Adjust the indicator following the manufacturers recommendations.

c. Slowly raise the sterndrive units until the trim limit point is reached. The trim limit point can be determined by measuring the amount of trim cylinder extension. The dimension for the Bravo sterndrive units is measured from front anchor point to rear anchor point centerlines as shown following.



50464

a - Trim limit dimension

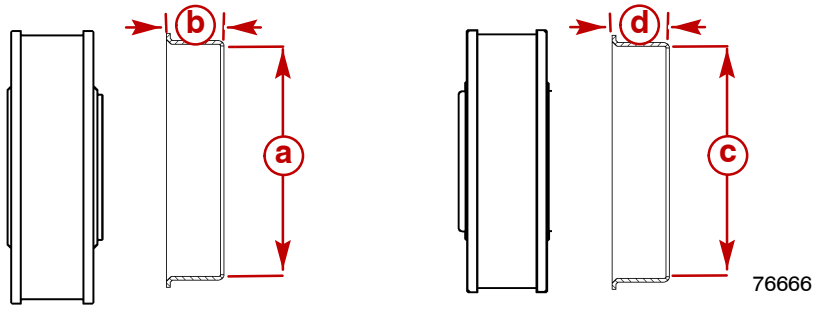
Description	
Trim limit dimension	552 mm (21-3/4 in.)

3. With the trim cylinders at this position, place a mark on the mechanical trim indicator in console.
   a. Raise and lower sterndrive units several times to ensure that the trim limit point is properly marked.

Gimbal Bearing

IMPORTANT: Gimbal bearing and carrier are a matched set and must be replaced as an assembly. Tolerance ring must be replaced any time gimbal bearing is removed.

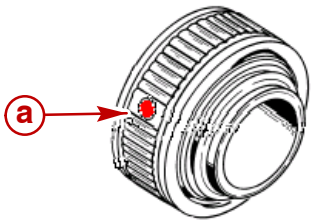
NOTE: *The gimbal bearing inner race thickness has changed to accommodate the larger U-joint used in the X, XZ, and XR Bravo sterndrive units. If an X, XZ, or XR sterndrive unit is installed on a transom with the thicker gimbal bearing, interference will occur between the U-joint and the bearing. Either one or both components will fail. The new gimbal bearing can be identified by a red dot.*



76666

New **Old**

a - 9.47 cm (3.73 in.)
b - 2.05 cm (0.81 in.)
c - 9.37 cm (3.69 in.)
d - 2.54 cm (1.00 in.)



79222

a - Red dot

Inspection

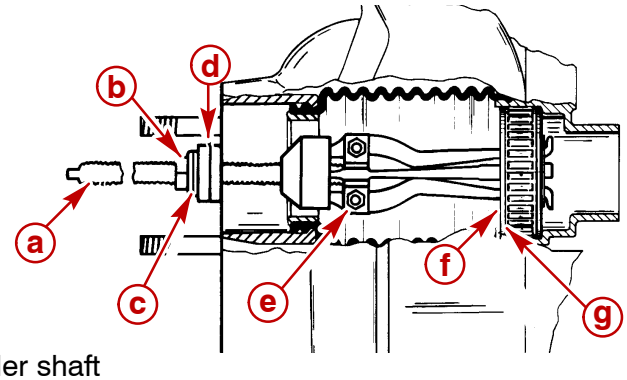
1. Remove sterndrive unit.
2. Reach through bell housing. Rotate gimbal bearing and check for rough spots. Pull and push on inner race to check for side wear. Any excessive movement or roughness is cause for replacement.

Removal

⚠ CAUTION

Do not remove gimbal bearing unless replacement is necessary, as damage to bearing may result during removal.

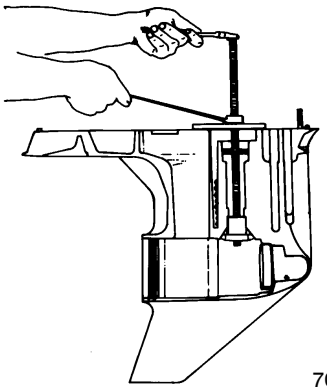
1. Remove gimbal bearing assembly.

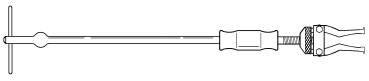


76658

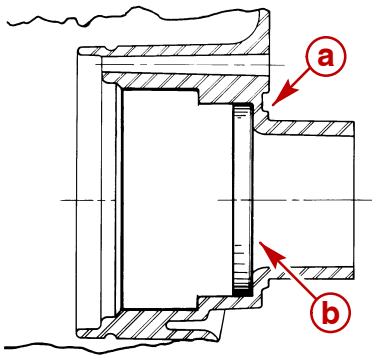
a - Puller shaft
b - Nut
c - Washer
d - Plates (3)
e - Slide Hammer Puller
f - Gimbal bearing inner race
g - Gimbal bearing carrier

NOTE: *Plate Puller included in Bearing Removal and Installation Tool Assembly part number 91-31339A7.*

Bearing Removal and Installation Tool Assembly		
 70615	Installs and removes the bearings on all Alpha and Bravo sterndrive gear cases. 91-31229A7 tool assembly includes the following components: 11-24156 Hex Nut 91-15755T Bearing Carrier 91-29310 Plate 91-29610 Pilot Plate 91-30366T1 Mandrel 91-31229 Puller Shaft 91-32325T Driver Head 91-32336 Driver Needle Bearing 12-34961 Washer 91-36379 Puller / Head Gear 91-36569T Driver Head 91-36571T Pilot Washer 91-37292 Roller Bearing 91-37311 Driver Head 91-37312 Driver Head 91-37323 Driver Head Rod 91-37324 Pilot Washer 91-38628T Puller / Driver Head 91-52393 Driver Needle Bearing 91-52394 Head Pull Rod	91-31229A7

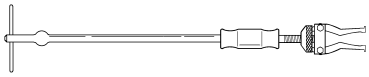
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

2. Remove grease seal using a Slide Hammer Puller.



22171

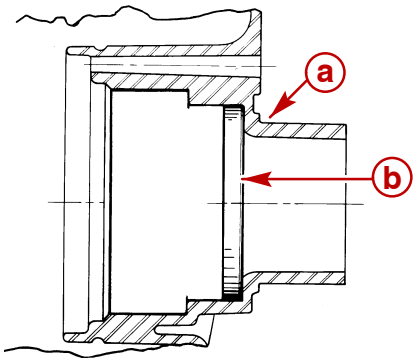
a - Gimbal housing
b - Grease seal

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

Installation

1. Install grease seal using a suitable mandrel.

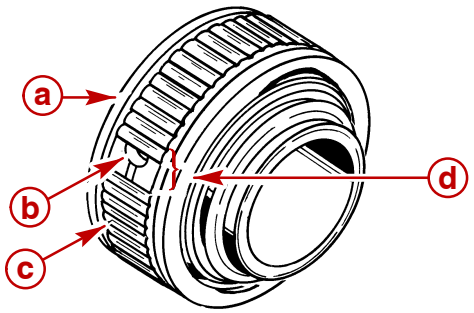
NOTE: *The seal should be installed with the open face of the seal towards the gimbal bearing.*



22171

a - Gimbal housing
b - Grease seal

2. Install and position new tolerance ring.



22159

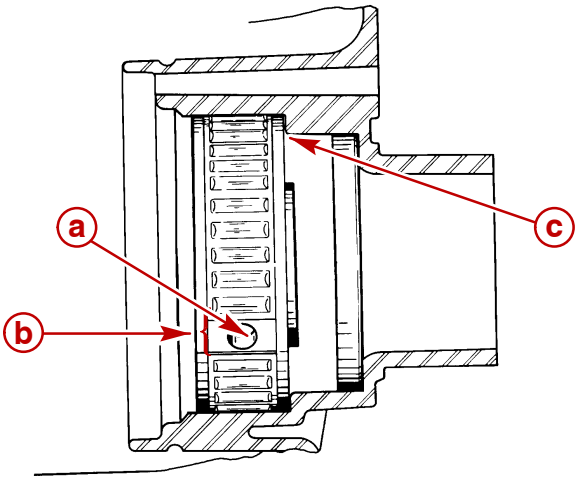
a - Carrier
b - Carrier grease hole
c - Tolerance ring
d - Opening in tolerance ring

3. Align opening in tolerance ring with grease hole in gimbal bearing cartridge.

IMPORTANT: Red dot on gimbal bearing must be positioned at 10 o'clock portside.

IMPORTANT: Ensure that notched edge of bearing carrier faces inward in bore.

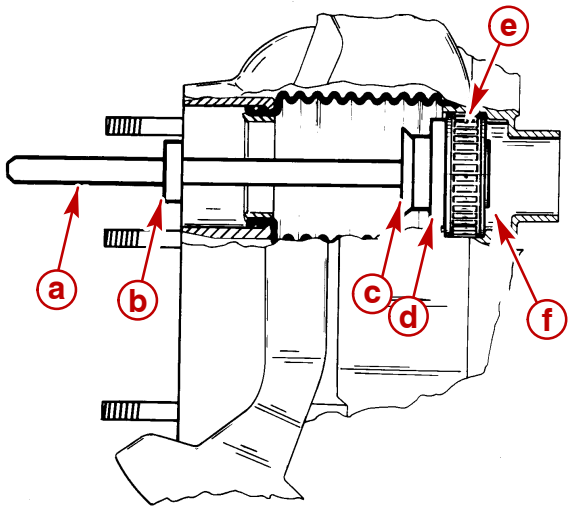
4. Align gimbal bearing carrier grease hole and tolerance ring opening with grease cavity hole in gimbal housing.



76559

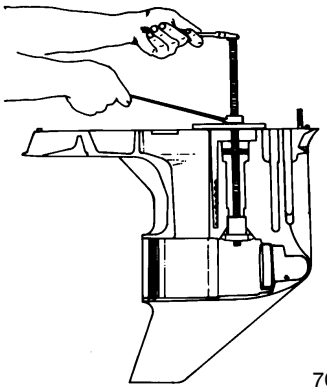
a - Gimbal bearing carrier grease hole
b - Tolerance ring opening
c - Bearing carrier notch

5. Install gimbal bearing with the red dot facing out toward the drive end using a brass hammer and tools shown. Ensure that the gimbal bearing carrier contacts gimbal housing.



22118

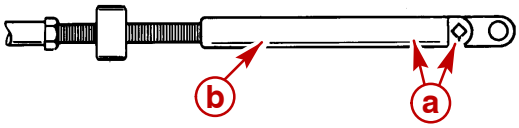
a - Drive Rod
b - Plate
c - Puller / Driver Head
d - Mandrel
e - Gimbal bearing assembly (red dot facing out)
f - Chamfer

Bearing Removal and Installation Tool Assembly		
 70615	Installs and removes the bearings on all Alpha and Bravo sterndrive gear cases. 91-31229A7 tool assembly includes the following components: 11-24156 Hex Nut 91-15755T Bearing Carrier 91-29310 Plate 91-29610 Pilot Plate 91-30366T1 Mandrel 91-31229 Puller Shaft 91-32325T Driver Head 91-32336 Driver Needle Bearing 12-34961 Washer 91-36379 Puller / Head Gear 91-36569T Driver Head 91-36571T Pilot Washer 91-37292 Roller Bearing 91-37311 Driver Head 91-37312 Driver Head 91-37323 Driver Head Rod 91-37324 Pilot Washer 91-38628T Puller / Driver Head 91-52393 Driver Needle Bearing 91-52394 Head Pull Rod	91-31229A7

Shift Cable

Removal

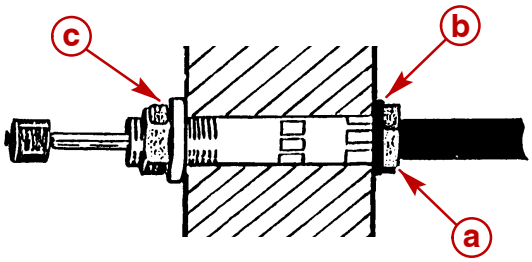
1. Remove sterndrive unit. Refer to **Section 2A**.
2. Disconnect shift cable from shift plate and remove end guide.



22183

a - Anchor screws (2) - loosen
b - End guide

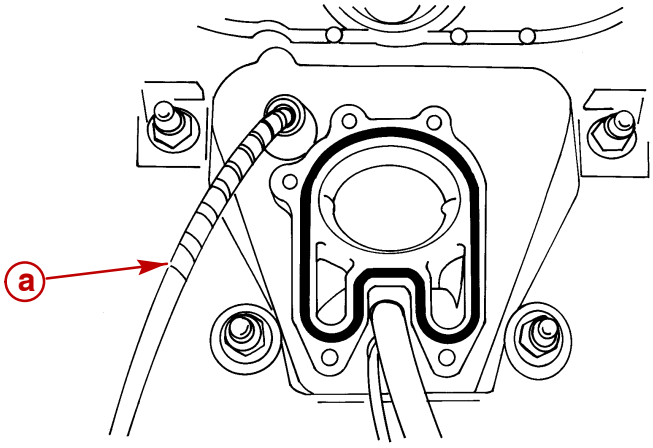
3. Hold shift cable retaining nut with wrench.
4. Remove flanged nut.



76673

a - Shift cable retaining nut
b - Seal washer
c - Flanged nut

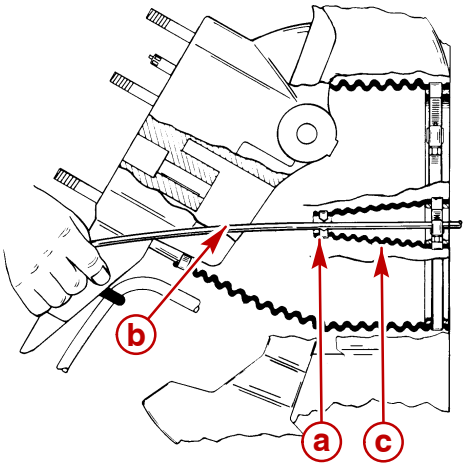
5. Remove shift cable wrapping.



76639

a - Shift cable wrapping

6. Loosen shift cable bellows crimp clamp.



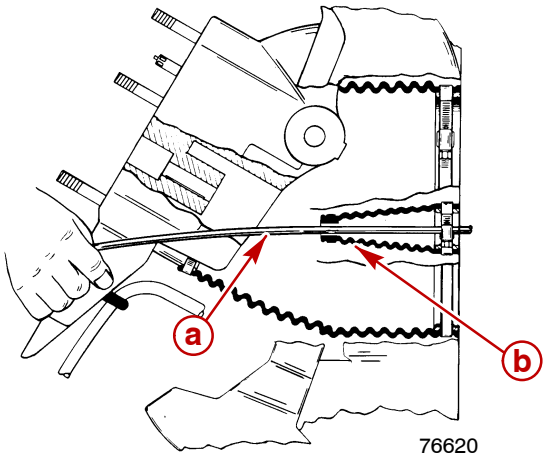
50458

a - Crimp clamp
b - Shift cable
c - Shift cable bellows

7. Pull shift cable through shift cable bellows.

Shift Cable Installation

1. Insert shift cable end into and through shift cable bellows.



76620

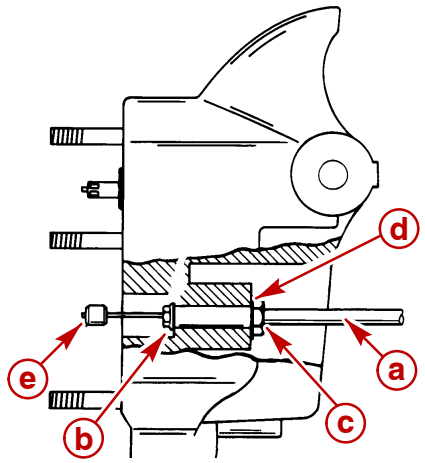
a - Shift cable end
b - Shift cable bellows

2. Apply sealant to flanged nut.

Description	Where Used	Part Number
Perfect Seal	Flanged nut threads	92-34227-1

3. Secure shift cable to bell housing.

4. Hold shift cable retaining nut with wrench and torque flanged nut.

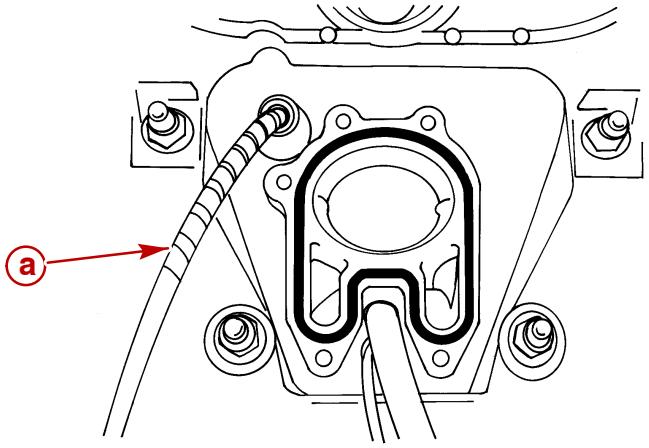


50327

a - Shift cable
b - Flanged nut
c - Shift cable retaining nut
d - Seal washer (hidden by nut)
e - Core wire

Description	Nm	lb-in.	lb-ft
Flanged nut	7	65	

5. Install shift cable wrapping approximately 51 mm (2 in.) from gimbal housing.



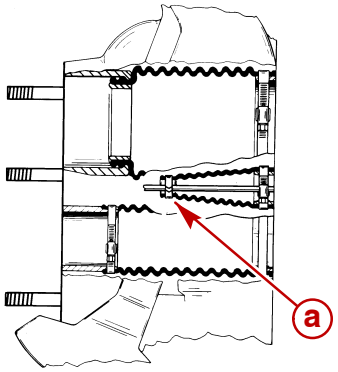
76639

a - Shift cable wrapping

⚠ CAUTION

Water leakage may result if clamp is not installed properly. Ensure that bellows end is not flattened out when crimping in the followlng step.

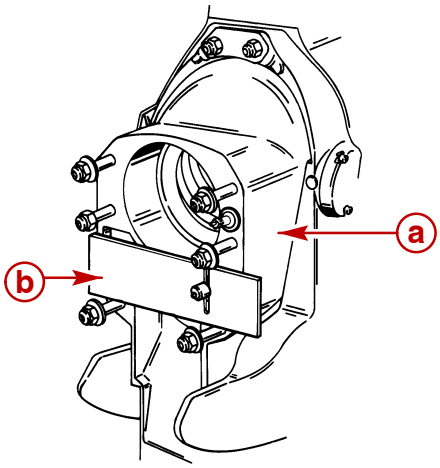
6. Install and compress shift cable bellows crimp clamp, maintaining a 13 mm (1/2 in.) diameter round OD. Ensure that clamp is crimped evenly to maintain a good seal between bellows and shift cable. Refer to Crimp Clamp Tool. Do not allow bellows to flatten.



22117

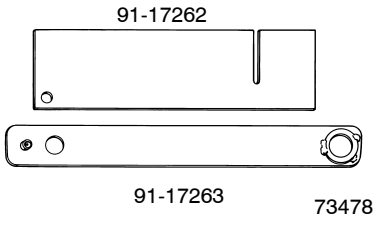
a - Crimp clamp

7. Install Core Wire Locating Tool on face of bell housing.

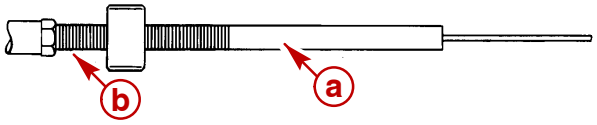


50327

a - Bell housing
b - Core Wire Locating Tool

Shift Cable Anchor Adjustment Tool		
 73478	Installs and removes shift shaft bushings on all the Bravo transom units. 91-17263 Core Wire Locating Tool 91-17262 Shift Cable Anchor Adjustment Tool	91-17262A1

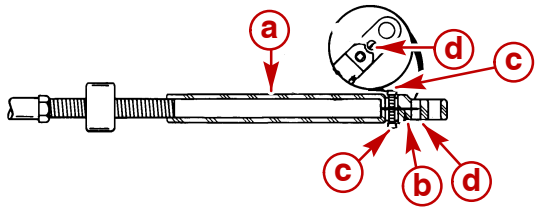
8. Install threaded tube until it contacts.
9. Tighten finger-tight.
10. Tighten jam nut securely.



22183

a - Threaded tube
b - Jam nut

11. Install cable end guide over core wire and insert core wire through cable anchor.
12. Ensure that core wire is visible in sight port. Tighten anchor screws evenly and torque.

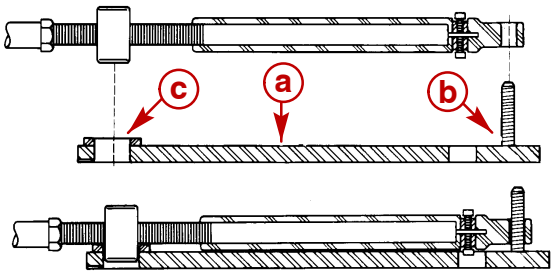


79263

a - Cable end guide
b - Core wire
c - Anchor screws
d - Sight port

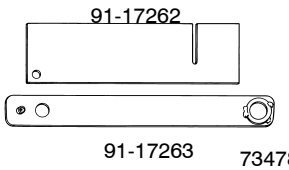
Description	Nm	lb-in.	lb-ft
Steering cable anchor screws	2.3	20	

13. Place Shift Cable Anchor Adjustment Tool on the end of the shift cable.

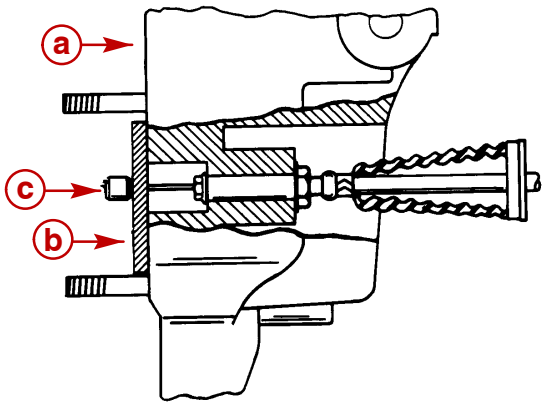


22120

a - Shift Cable Anchor Adjustment Tool
b - Stud
c - Hole barrel placed here

Shift Cable Anchor Adjustment Tool		
 73478	Installs and removes shift shaft bushings on all the Bravo transom units. 91-17262 Shift Cable Anchor Adjustment Tool	91-17262A1

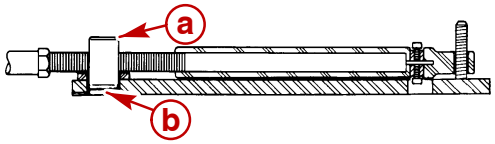
14. Ensure that bell housing end of core wire is positioned tight against Core Wire Locating Tool.



22121

a - Bell housing
b - Core Wire Locating Tool
c - Core wire

15. Adjust cable barrel to align with hole in tool.
16. Remove tools and install cable on shift plate assembly, being careful not to move the adjustment.



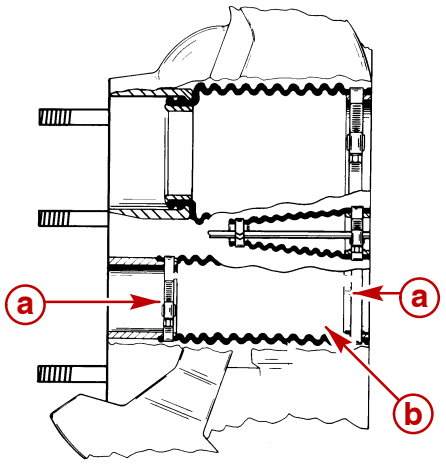
22120

a - Barrel
b - Hole in tool

Exhaust Bellows (If Equipped)

Removal

1. Remove sterndrive unit. Refer to **Section 2A**.
2. Loosen clamps and remove bellows.



22116

a - Clamps
b - Bellows

Cleaning and Inspection

1. Inspect exhaust bellows for internal charring, cracks, cuts, or hardening.
2. Clean old adhesive from bellows mounting flange on gimbal housing and on bell housing with lacquer thinner.

Description	Where Used	Part Number
Lacquer Thinner	Bellows mounting flange	Obtain Locally

3. Clean old adhesive from mounting surface of exhaust bellows if using old bellows.
4. Roughen exhaust bellows mating surfaces with sandpaper and wipe clean with lacquer thinner.

Description	Where Used	Part Number
Lacquer Thinner	Bellows mounting flange	Obtain Locally

Installation

IMPORTANT: All replacement bellows should be part number 18654A1. Do not use earlier model bellows.

⚠ WARNING

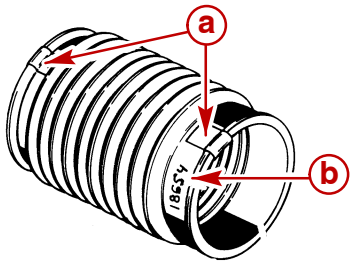
Be sure to follow label directions when using Bellows Adhesive.

1. Apply adhesive to mounting surfaces on inside of bellows. Allow adhesive to dry until no longer tacky (approximately 10 minutes).

⚠ CAUTION

Bellows clamps may corrode if grounding clips are not installed.

2. Position grounding clips on bellows.

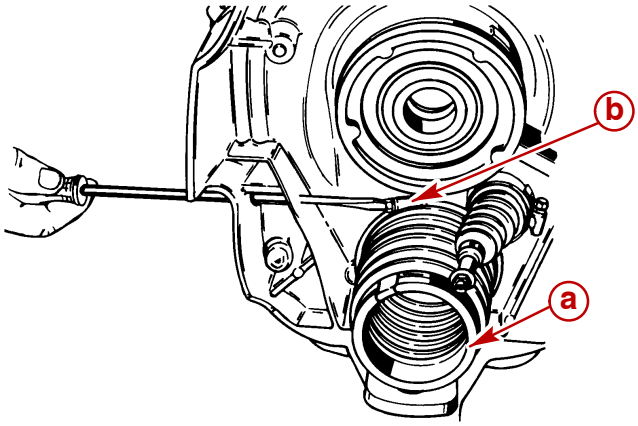


22079

a - Grounding clips
b - Part number

Description	Where Used	Part Number
Bellows Adhesive	Mounting surfaces on inside of bellows	92-86166Q1

3. Install exhaust bellows on gimbal housing and torque clamp.

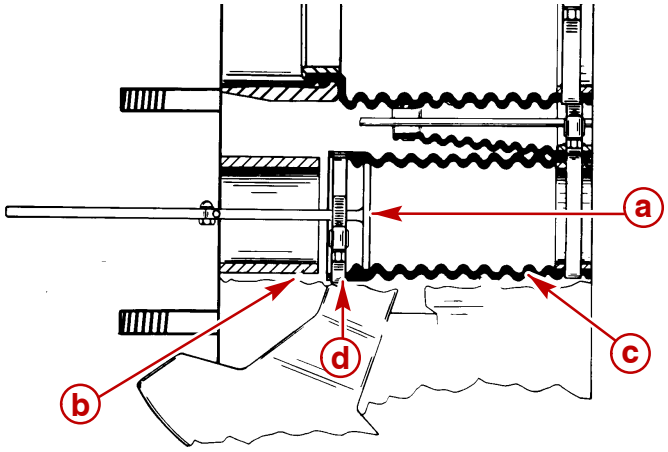


76660

a - Exhaust bellows
b - Hose clamp

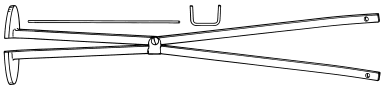
Description	Nm	lb-in.	lb-ft
Exhaust bellows hose clamp	4	35	

4. Place hose clamp over bellows end.
5. Place Bellows Expander Tool into first bellows convolution.
6. Pull tool until tool touches the flange on bell housing (bellows starts to slip onto flange) and then release tool.

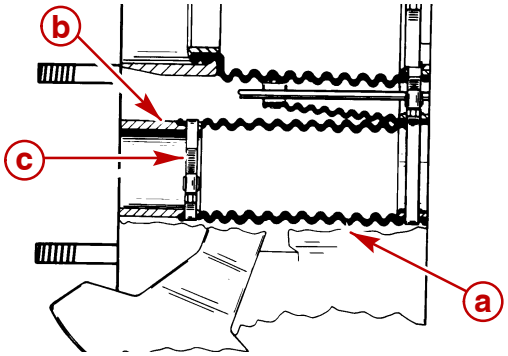


22116

a - Bellows Expander Tool
b - Bell housing flange
c - Exhaust bellows
d - Hose clamp

Bellows Expander Tool		
 73430	Installs the exhaust bellows on the Bravo One, and Bravo Two sterndrive units.	91-45497A1

7. Reposition tool into the third bellows convolution.
8. Pull bellows onto bell housing flange.
9. Torque hose clamp.



22116

a - Exhaust bellows
b - Bell housing flange
c - Hose clamp

Description	Nm	lb-in.	lb-ft
Exhaust bellows hose clamp	4	35	

Exhaust Tube (If Equipped)

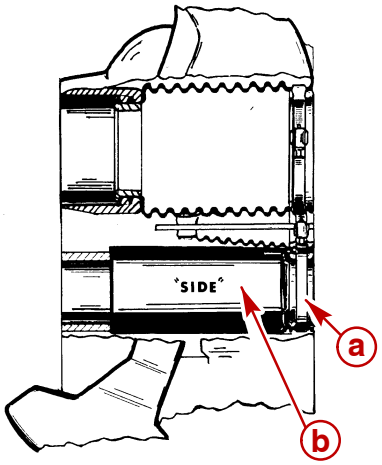
Removal

NOTE: *It is not necessary to remove sterndrive unit when replacing exhaust tube.*

⚠ CAUTION

Support aft end of sterndrive unit when working between bell housing and gimbal housing.

1. Raise sterndrive unit to the full UP/OUT position.
2. Loosen hose clamp and remove exhaust tube.



22184

a - Hose clamp
b - Exhaust tube

Cleaning and Inspection

1. Inspect exhaust tube for charring, cracks, cuts, and hardening.
2. Roughen exhaust tube mating surfaces with sandpaper and wipe clean with lacquer thinner.

Description	Where Used	Part Number
Lacquer Thinner	Bellows mounting flange	Obtain Locally

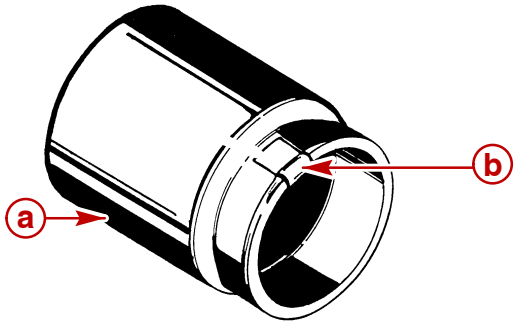
Installation

NOTE: *Bellows adhesive is not used when installing an exhaust tube.*

⚠ CAUTION

Exhaust tube clamp may corrode if grounding clip is not installed.

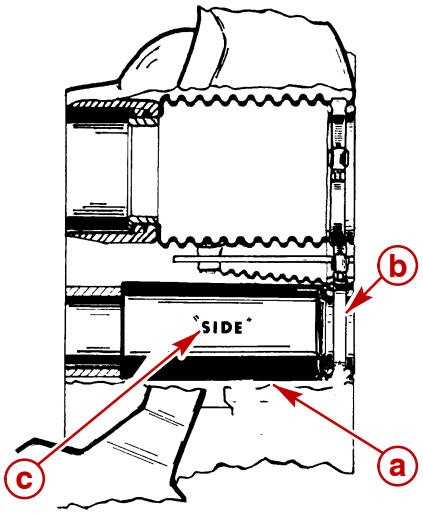
1. Position grounding clip on exhaust tube.



22184

a - Exhaust tube
b - Grounding clip

2. Position tube so that side markings on tube are facing toward the right and left sides.
3. Position clamp so that screw will align with screwdriver access hole in port (left) side of gimbal housing.
4. Tighten and torque hose clamp.



22184

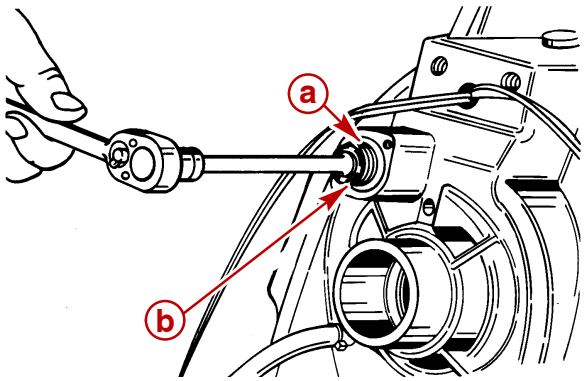
a - Exhaust tube
b - Hose clamp
c - Side marking

Description	Nm	lb-in.	lb-ft
Exhaust tube hose clamp	4	35	

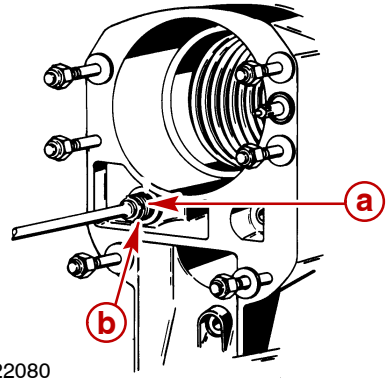
Water Hose and Water Fitting

Removal

1. Remove tapered inserts.

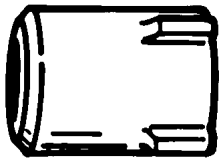


22080

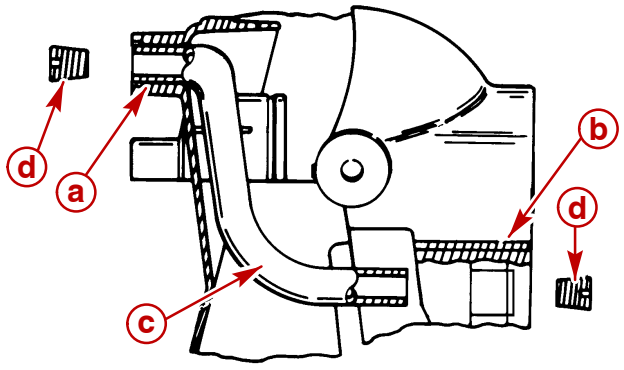


50322

a - Tapered inserts
b - Tapered Insert Tool

Tapered Insert Tool		
 73456	Installs and removes the tapered insert retainer into the water inlet hose on all the Bravo sterndrive units.	91-43579

2. Remove water hose.



22101

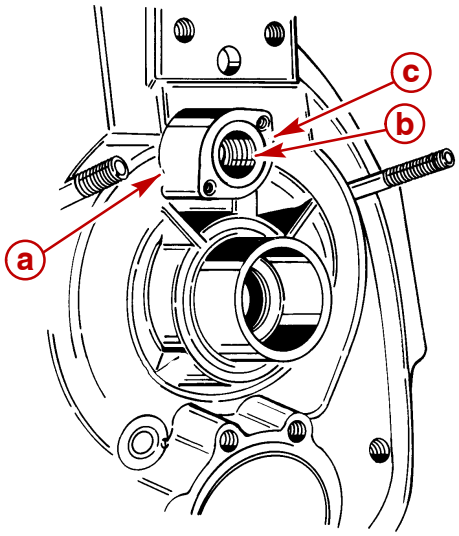
a - Gimbal housing
b - Bell housing
c - Water hose
d - Tapered inserts

Installation

⚠ CAUTION

The water hose in the following step is a preformed hose and must be installed with the short end of the molded hose going into the gimbal housing. The hose must be held in place while installing the tapered inserts. Failure to hold hose in place can result in an overheat condition.

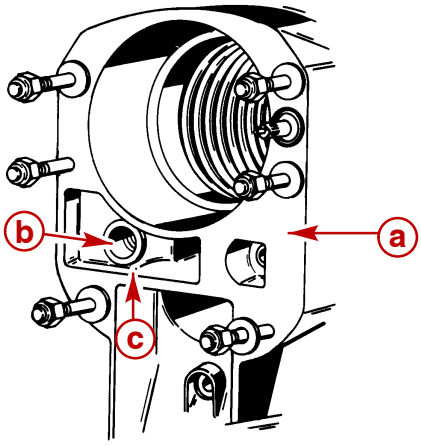
1. Position water hose as follows:
   a. Gimbal Housing - hose edge must be flush with mounting surface.



22080

a - Gimbal housing
b - Water hose
c - Mounting surface

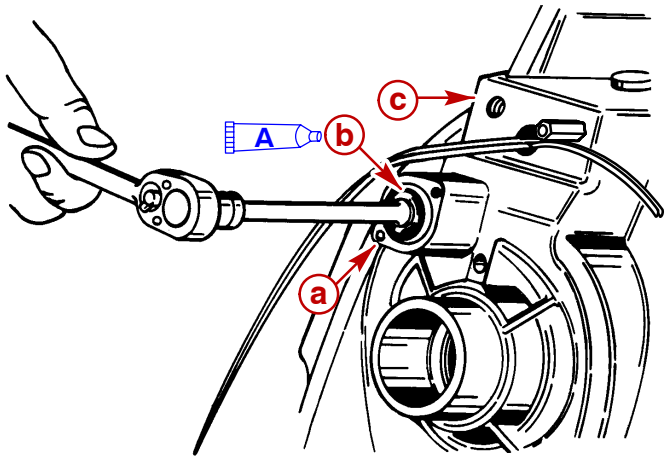
   b. Bell Housing - hose edge should protrude approximately 3 mm (1/8 in.) from edge of hole.



50322

a - Bell housing
b - Water hose
c - Hole

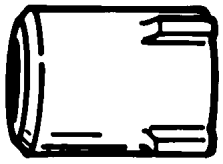
2. Lubricate threads of tapered inserts.
3. Install tapered inserts with Tapered Insert Tool.



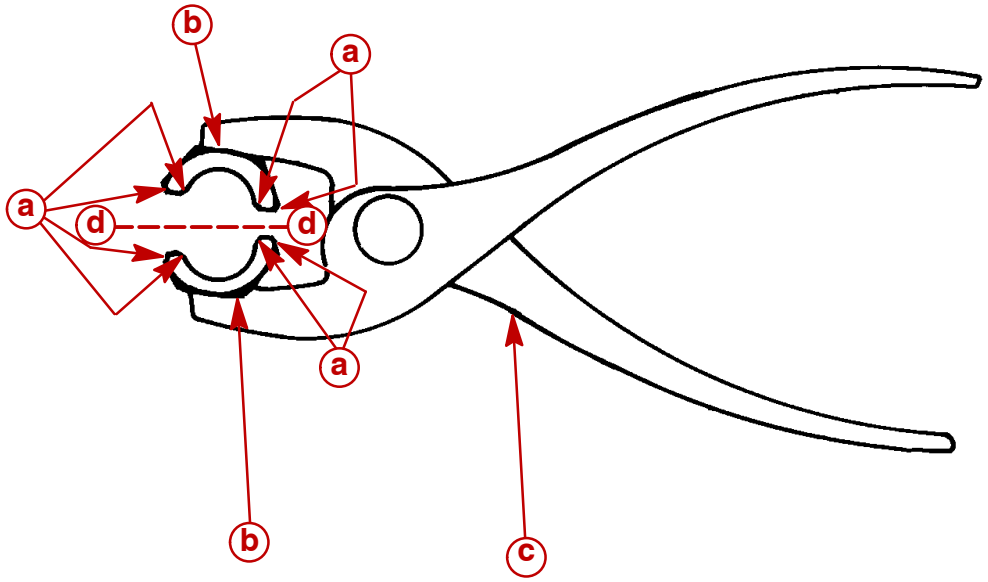
75962

a - Tapered insert
b - Tapered Insert Tool
c - Gimbal housing

Description		Where Used	Part Number
A	2-4-C with Teflon	Threads of tapered insert	92-802859A1

Tapered Insert Tool		
 73456	Installs and removes the tapered insert retainer into the water inlet hose on all the Bravo sterndrive units.	91-43579

Crimp Clamp Tool



74148

a - Bevel edges
b - 3/4 in. nut
c - Pliers
d - Nut (cut in half)

1. Weld a 3/4 in. nut to the jaws of a pair of pliers.
2. Saw the nut in half without damaging the pliers.
3. Clamp the jaws of the pliers in a vice so that the 2 halves of the nut are pressed firmly together.
4. Use a 1/2 in. drill bit to drill out the threads of the nut.
5. Remove the pliers from the clamp and bevel the edges of the nut.

NOTES:

TRANSOM ASSEMBLY

Section 4B - Service Procedures Requiring Major Disassembly

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Standard And High Performance Transom Assemblies 4B-55
Shift Cable Installation 4B-60
Crimp Clamp Tool 4B-64
Bravo Access Plug Drilling Template 4B-65

4 B

Bravo Transom Assembly Specifications

Parts List

Description	Part Number
Access plug kit	22-88847A-1

Torque Specifications

Description	Nm	lb-in.	lb-ft
Bellows clamp	4	35	
Hose clamp on shift cable bellows	4	35	
Hose clamp on exhaust bellows	4	35	
Hex fitting	4	35	
Gimbal ring locknuts	72		53
Steering lever clamping bolt and nut	68		50
Bell housing hinge pins	197		145
Hinge pin screws	3.3	28	
Exhaust bellows hose clamp	4	35	

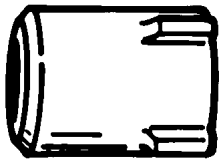
Lubricants / Sealants / Adhesives

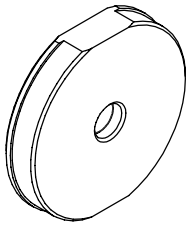
Description	Where Used	Part Number
Bellows Adhesive	U-joint bellows	92-86166Q1
	Exhaust bellows	
	O-ring	
	Shift cable bellows	
	Mounting surfaces on inside of bellows	
2-4-C with Teflon	To threads of tapered insert	92-802859A1
	Clamp screw	
Perfect Seal	Flanged nut threads	92-34227-1
	Water bypass plug	
	Bayonet fitting	
Loctite 271 Threadlocker	Bell housing threads	92-809819
	Studs	
	Seal	
	Washer inner surface	
High Performance Gear Lube	Gear lube valve O-rings	92-802854A1
Sealer Kit, Two Part Epoxy	Bushing	92-65150-1
	Bushings	
U-Joint and Gimbal Bearing Grease	Gimbal bearing	92-802870A1
Super Glue	Gimbal housing seal	Obtain locally
	Exhaust passage seal	
Soapy water or engine cleaner	Sleeve outside diameter	Obtain locally
Phantom Black Spray Paint	Any bare metal spots	92-802878

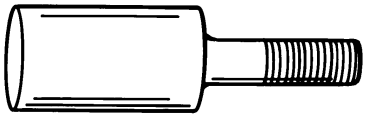
Tools

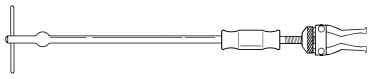
Description	Part Number
Hole Saw (1-1/8 in.) and pilot rod	Obtain locally
Pipe tap, 1 in. NPT	Obtain locally

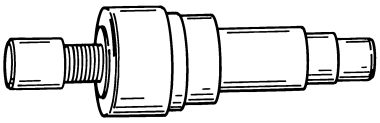
Special Tools

Tapered Insert Tool		
 73456	Installs and removes the tapered insert retainer into the water inlet hose on all the Bravo transom units.	91-43579

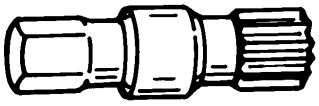
Retention Sleeve Removal Tool		
 78063	Use to remove the U-joint bellows retention sleeve on all the Bravo 2000 transom assemblies. Used also to remove the aluminum sleeve from the U-joint bellows of all Bravo transom units, Serial Number 0L99999 and below.	91-862546

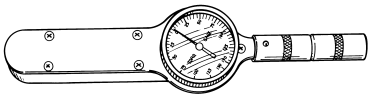
Puller Head		
 73428	Removes hinge pin from the Bravo One, Bravo Two and Bravo Three High Performance sterndrive units.	91-63616T

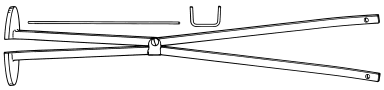
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

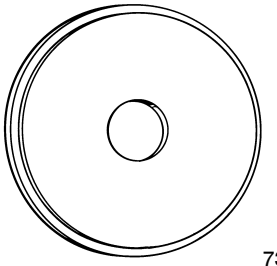
Bushing / Bearing / Seal Driver		
 73444	Installs the Bravo transom assembly bushings, bearings and seals.	91-43578A1

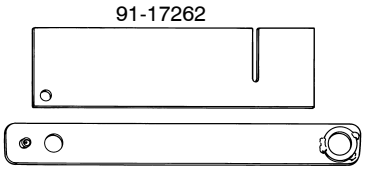
Special Tools (continued)

Hinge Pin Tool		
 73443	Installs and removes the hinge pins from all Mercury MerCruiser sterndrive units.	91-78310

Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

Bellows Expander Tool		
 73430	Installs the exhaust bellows on the Bravo One, Bravo Two transom units.	91-45497A1

Sleeve Installation Tool		
 73485	Installs the aluminum sleeve in the U-joint bellows of all the Bravo transom units.	91-818162

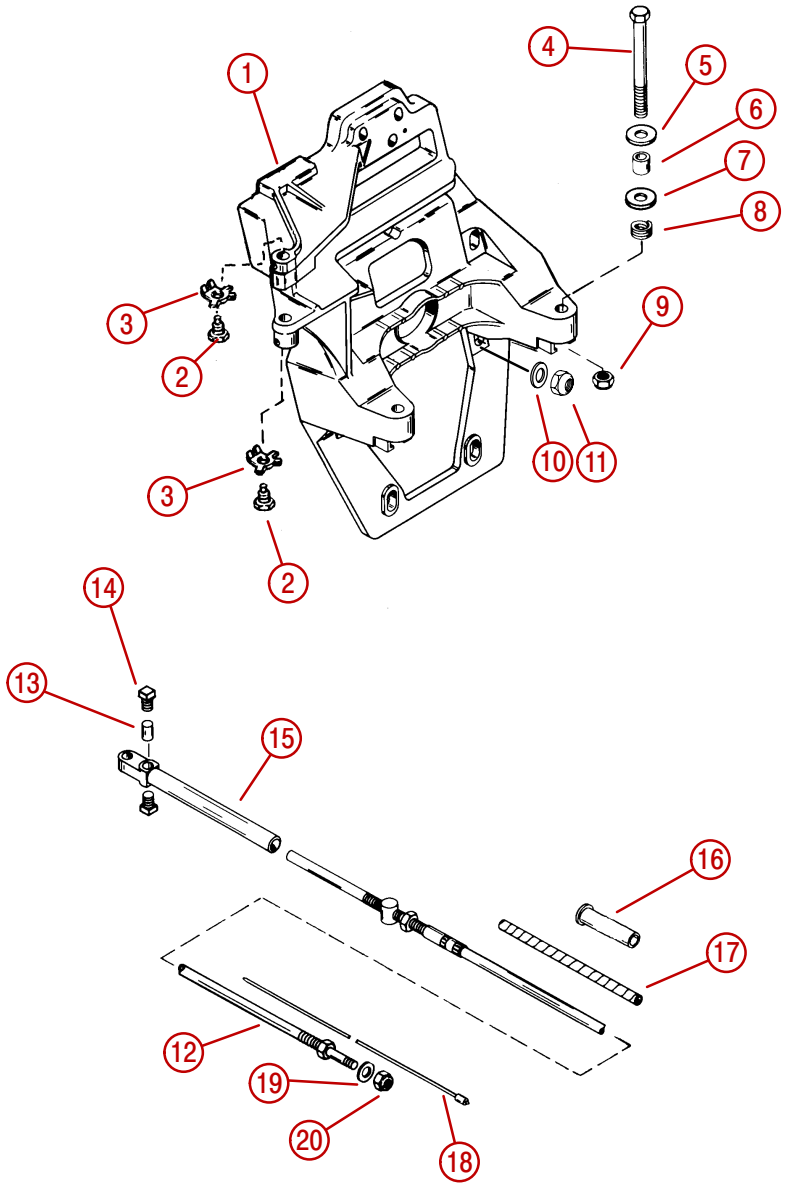
Shift Cable Anchor Adjustment Tool		
 73478	91-17263 Core Wire Locating Tool 91-17262 Shift Cable Anchor Adjustment Tool	91-17262A1

Snap-On Tools

Snap-On Tools 2801 80th Street Kenosha, WI 53141 See Snap-On Catalog for phone number of distributor in your region.	
Description	**Part Number**
Bushing removal tool	CG40CB

Bravo Transom Assembly Exploded Views

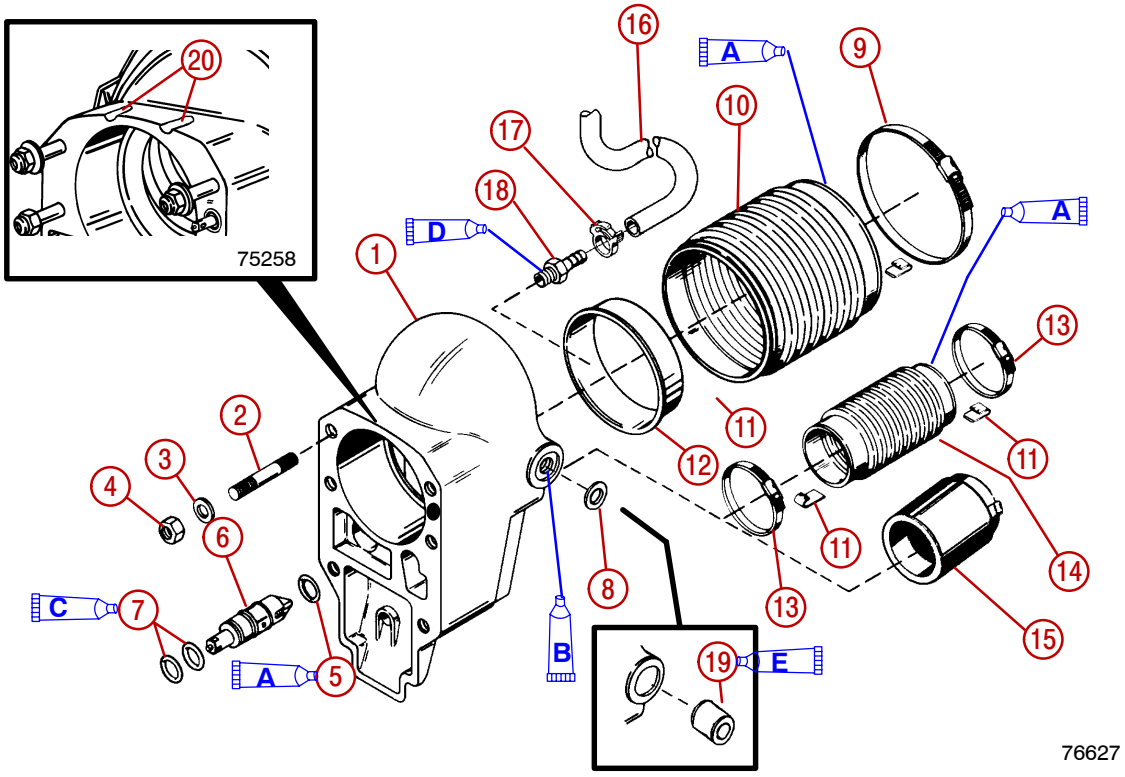
Inner Transom Plate Components



76857

1 - Transom plate assembly
2 - Pivot bolts
3 - Tab washers
4 - Rear engine mounting bolt
5 - Washer
6 - Spacer
7 - Washer - fiber
8 - Lockwasher - double wound
9 - Locknut
10 - Washer
11 - Locknut
12 - Shift cable casing
13 - Core wire anchor
14 - Set screws (2)
15 - End guide
16 - Nylon tube
17 - Nylon wrapping
18 - Core wire
19 - Sealing washer
20 - Nut

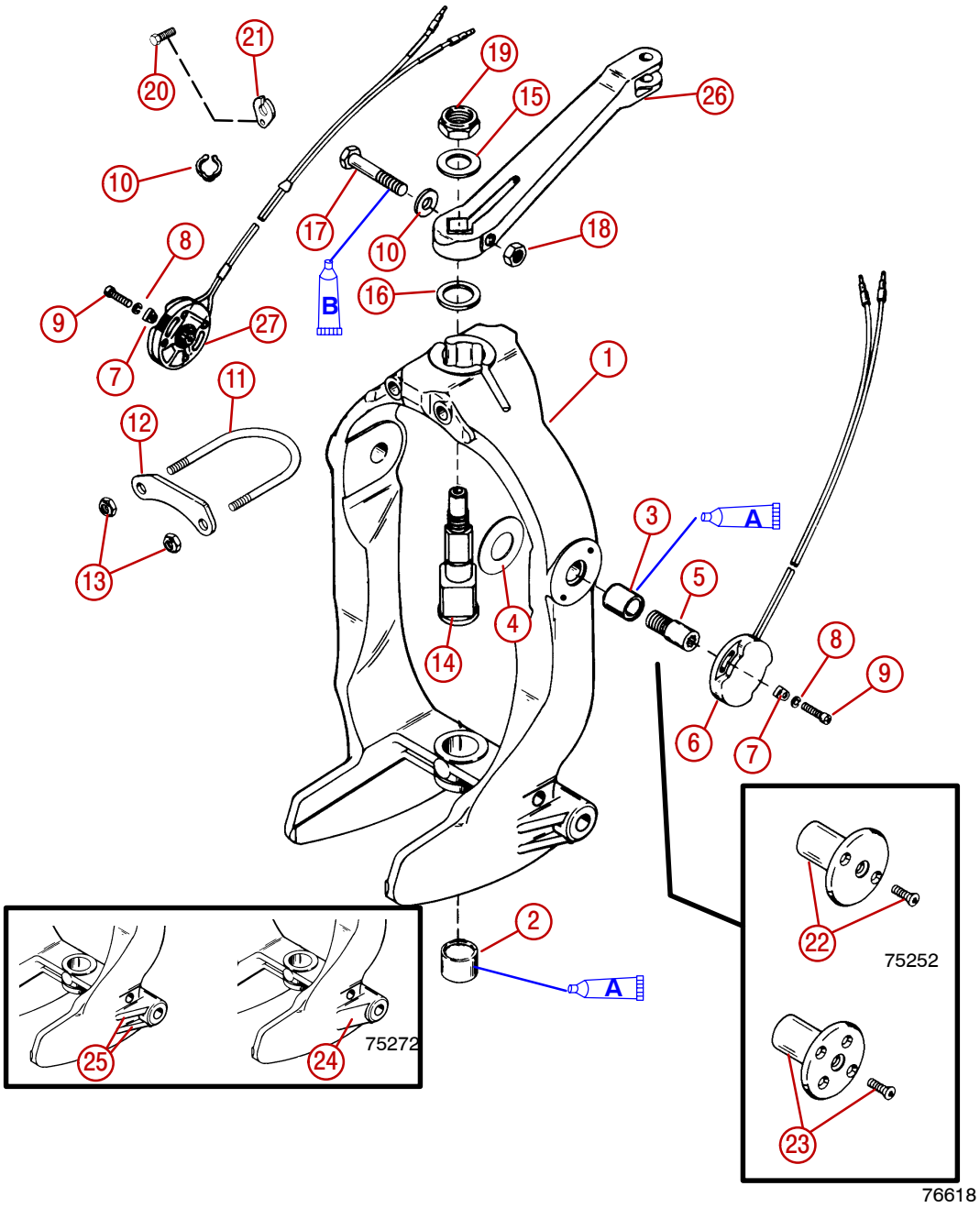
Bell Housing Components



1 - Bell housing
2 - Stud
3 - Washer
4 - Locknut
5 - O-ring (bell housing)
6 - Gear lube valve
7 - O-rings (gear lube valve)
8 - Hinge pin washer
9 - Bellows clamp
10 - U-joint bellows
11 - Grounding clip
12 - Sleeve
13 - Bellows clamp
14 - Exhaust bellows
15 - Exhaust tube (some models)
16 - Lube monitor hose
17 - Hose clamp
18 - Bayonet fitting
19 - Bushing (High Performance transom)
20 - Indentations in bell housing

Description		Where Used	Part Number
A	Bellows Adhesive	U-joint bellows	92-86166Q1
		Exhaust bellows	
		O-ring	
B	Loctite 271 Threadlocker	Washer inner surface	92-809819
C	High Performance Gear Lube	Gear lube valve O-rings	92-802854A1
D	Perfect Seal	Bayonet fitting	92-34227-1
E	Sealer Kit, Two Part Epoxy	Bushing	92-65150-1

Gimbal Ring Components

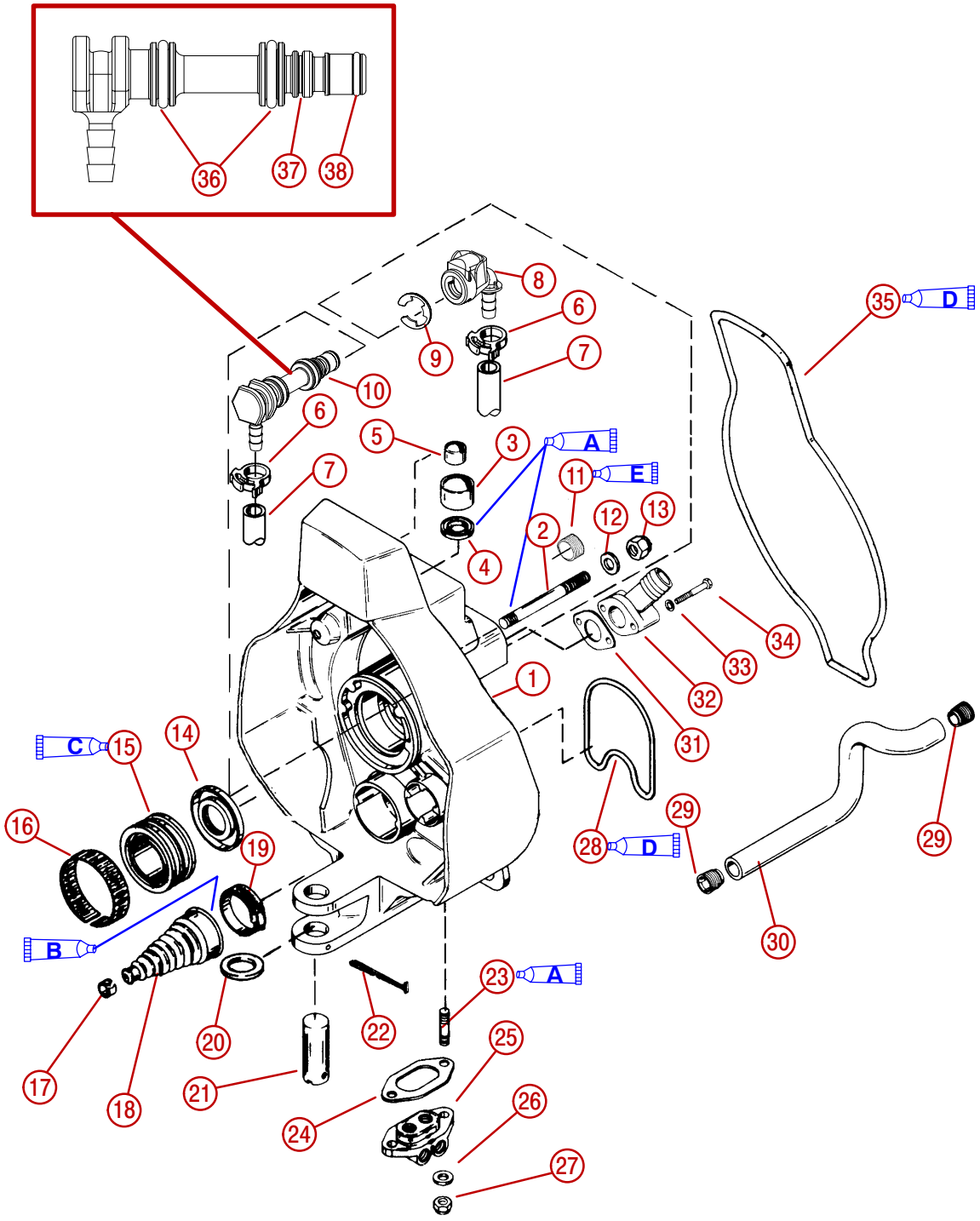


Gimbal Ring Components (continued)

1 - Gimbal ring
2 - Bushing
3 - Bushing
4 - Flat washer
5 - Hinge pin
6 - Trim position sender
7 - Flat washer
8 - Lockwasher
9 - Screw
10 - Washer
11 - U-Bolt
12 - Plate
13 - Locknuts
14 - Swivel shaft
15 - Flat washer (smaller ID)
16 - Flat washer (larger ID)
17 - Locknut
18 - Clamp screw
19 - Nut
20 - Screw
21 - Clamp plate
22 - High Performance hinge pin assembly (early style) (2 screws)
23 - High Performance hinge pin assembly (later style) (4 screws)
24 - Magnum and High Performance gimbal ring identification (filled area)
25 - Standard gimbal ring identification (2 ribs)
26 - Steering lever
27 - Trim limit switch

Description		Where Used	Part Number
A	Sealer Kit, Two Part Epoxy	Bushings	92-65150-1
B	2-4-C with Teflon	Clamp screw	92-802859A1

Gimbal Housing Components



76642

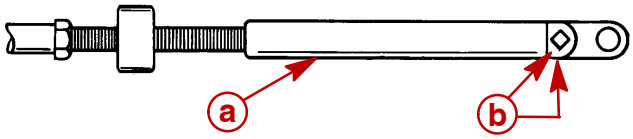
Gimbal Housing Components (continued)

1 - Gimbal housing
2 - Stud
3 - Lower swivel shaft bushing
4 - Seal
5 - Upper swivel shaft bushing
6 - Clamp
7 - Lube monitor hose
8 - Quick disconnect fitting
9 - E-clip
10 - Gear lube fitting
11 - Water bypass plug
12 - Flat washer
13 - Locknut
14 - Seal
15 - Gimbal bearing
16 - Tolerance ring
17 - Crimp clamp
18 - Shift cable bellows
19 - Bellows clamp
20 - Washer
21 - Lower swivel pin
22 - Cotter pin
23 - Stud
24 - Gasket
25 - Hydraulic manifold
26 - Washer
27 - Locknut
28 - Exhaust passage seal
29 - Water hose insert
30 - Water hose
31 - Water fitting gasket
32 - Water fitting
33 - Lockwasher
34 - Screw
35 - Gimbal housing seal
36 - Large O-rings
37 - Snap ring groove
38 - Small O-ring

Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Studs	92-809819
		Seal	
B	Bellows Adhesive	Shift cable bellows	92-86166Q1
C	U-Joint and Gimbal Bearing Grease	Gimbal bearing	92-802870A1
D	Super Glue	Gimbal housing seal	Obtain locally
		Exhaust passage seal	
E	Perfect Seal	Water bypass plug	92-34227-1

Bell Housing Removal

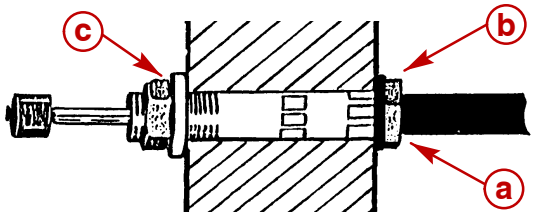
1. Remove sterndrive unit. Refer to **Section 2A**.
2. Remove shift cable from bell housing by loosening anchor screws and disconnecting shift cable end guide from shift bracket.
3. Remove end guide.



22183

a - End guide
b - Anchor screws (2)

4. Remove flanged nut. Hold shift cable retaining nut with wrench.

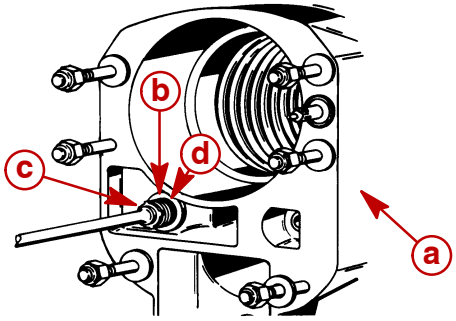


76673

a - Shift cable retaining nut
b - Seal washer
c - Flanged nut

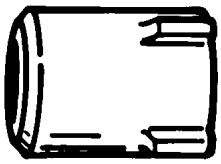
5. Turn tapered insert COUNTERCLOCKWISE to remove from ID of water hose.

6. Remove water hose from bell housing.

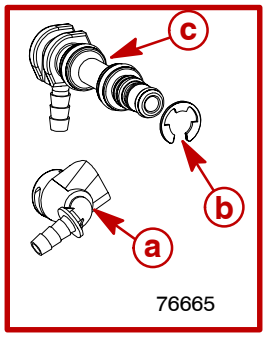


50322

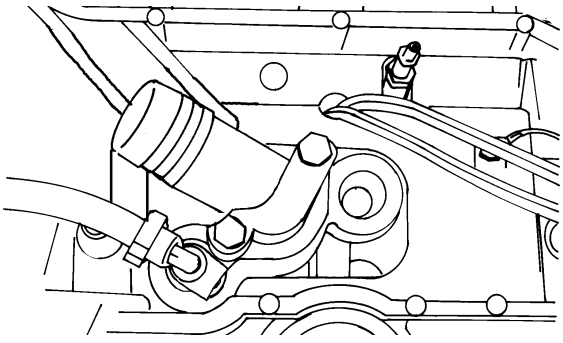
a - Bell housing
b - Tapered insert
c - Tapered Insert Tool
d - Water hose

Tapered Insert Tool		
 73456	Installs and removes the tapered insert retainer into the water inlet hose on all the Bravo transom units.	91-43579

7. Remove gear lube monitor 90 degree quick disconnect fitting and through bulkhead fitting E-clip so that fitting will pull out of gimbal housing upon removal of bell housing.



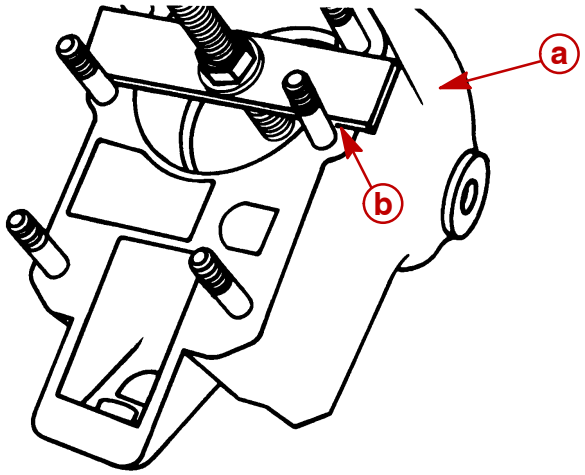
76665



76640

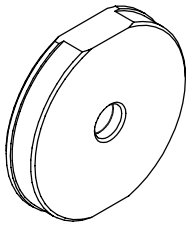
a - Quick disconnect fitting
b - E-clip
c - Through bulkhead fitting

8. Spray engine cleaner around edge of bellows sleeve and remove with Retention Sleeve Removal Tool.

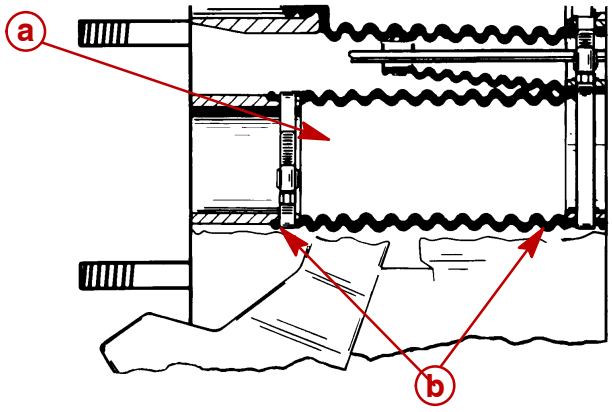


71526

a - Bell housing
b - Retention Sleeve Removal Tool

Retention Sleeve Removal Tool		
 78063	Use to remove the U-joint bellows retention sleeve on all the Bravo 2000 transom assemblies. Used also to remove the aluminum sleeve from the U-joint bellows of all Bravo transom units, Serial Number 0L99999 and below.	91-862546

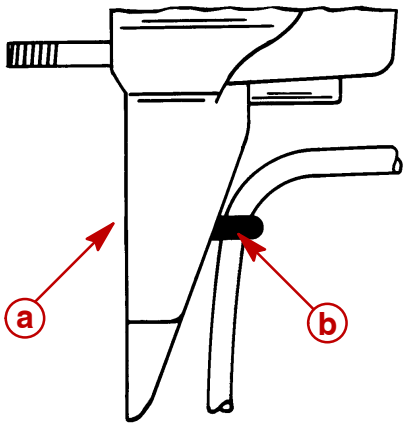
9. Loosen hose clamps.
10. Remove exhaust bellows from bell housing.



22116

a - Exhaust bellows
b - Hose clamps

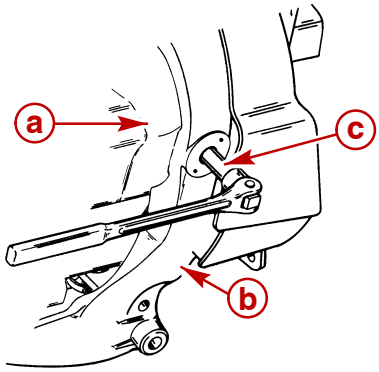
11. Remove speedometer tubing clip from bell housing.



22121

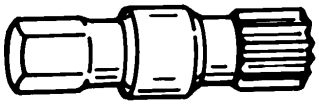
a - Bell housing
b - Speedometer tubing clip

12. **Standard Transom Assembly:** Remove port and starboard hinge pins.
    a. Using the Hinge Pin Tool, loosen and remove hinge pin.



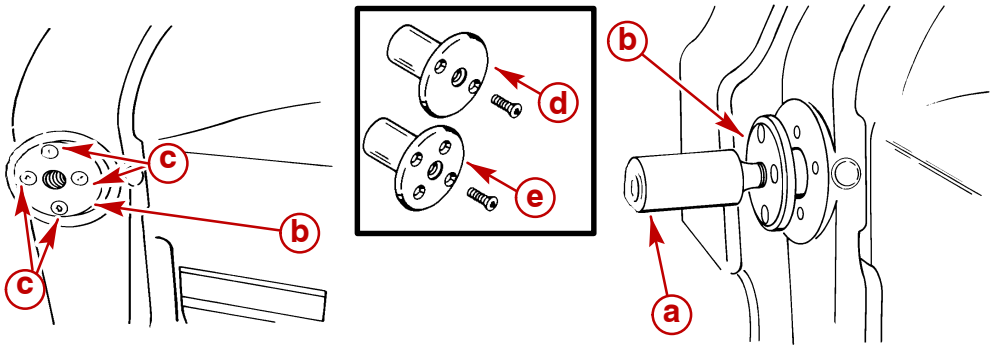
22113

a - Bell housing
b - Gimbal ring
c - Hinge Pin Tool

Hinge Pin Tool		
 73443	Installs and removes the hinge pins from Mercury MerCruiser gimbal ring and bell housing assemblies.	91-78310

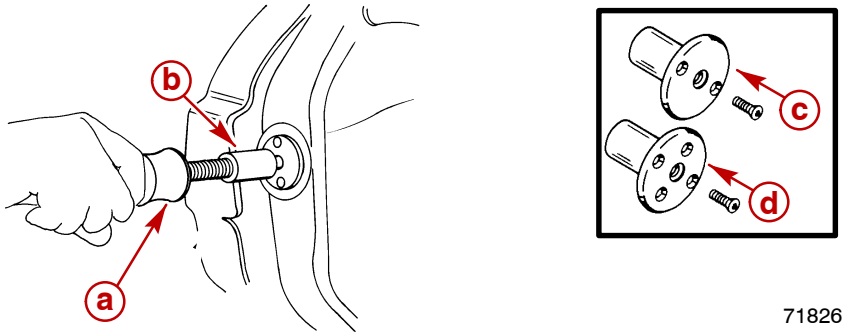
13. **High Performance Transom Assembly:** Remove port and starboard hinge pins using special Puller Head and Slide Hammer Puller as follows:

a. Remove torx screws and thread Puller Head into the hinge pin.

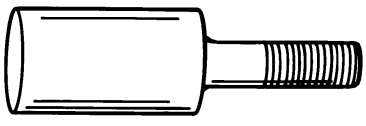


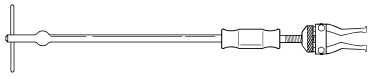
a - Puller Head
b - Hinge pin
c - Screw holes
d - High Performance hinge pin early style (2 screws)
e - High Performance hinge pin later style (4 screws)

b. Remove hinge pin using the Slide Hammer Puller.



a - Slide Hammer Puller
b - Puller Head
c - High Performance hinge pin early style (2 screws)
d - High Performance hinge pin later style (4 screws)

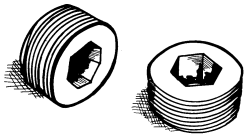
Puller Head		
 73428	Removes hinge pin from the Bravo One, Bravo Two and Bravo Three High Performance sterndrive units.	91-63616T

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

Access Plug Kit Installation

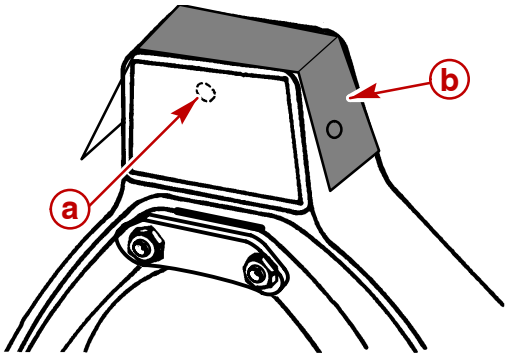
NOTE: *If steering lever cavity is not accessible, it will be necessary to drill access holes in gimbal housing. This procedure requires the following:*

Description	Part Number
Access plug kit	22-88847A-1



22756

1. Use template at the end of this section as a guide for the correct location for cutting and drilling access holes.
2. Align template with dimple located beneath decal on the gimbal housing.



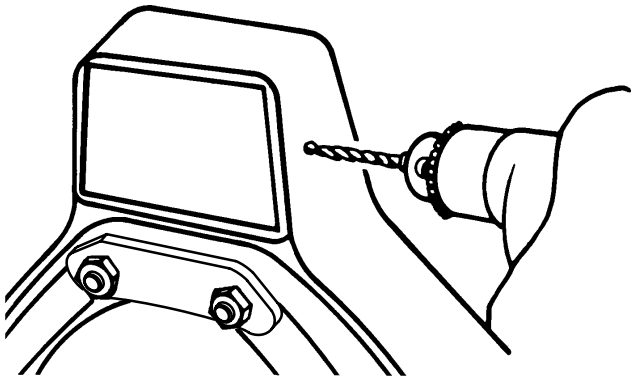
76628

a - Dimple (beneath decal)
b - Template

⚠ CAUTION

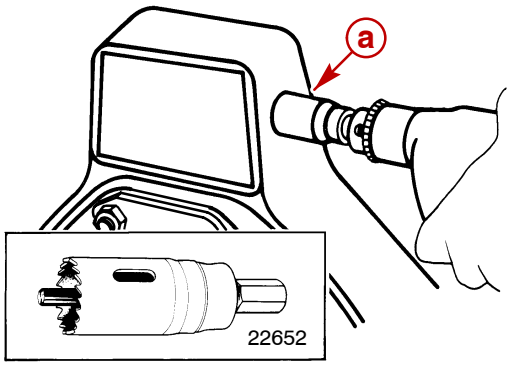
Drill and cut hole and tap threads perpendicular to gimbal housing surfaces in the following steps.

3. Drill pilot holes (port and starboard) using a 1/4 in. drill bit.



75915

4. Cut holes in gimbal housing (port and starboard) using a hole saw and pilot rod.

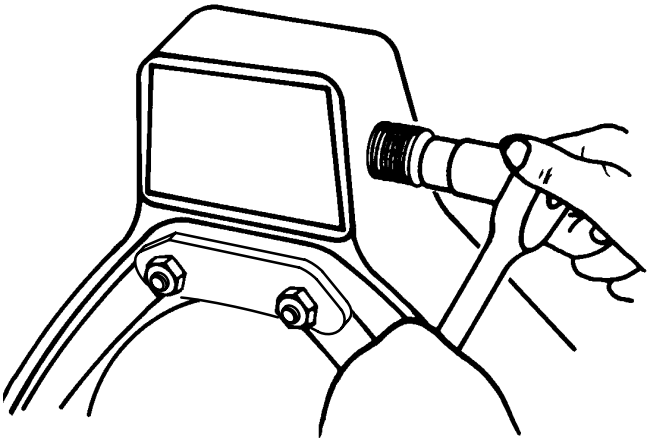


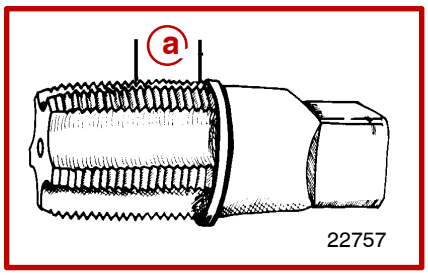
70153

a - Hole saw

Description	Part Number
Hole saw (1-1/8 in.) and pilot rod	Obtain locally

5. Remove metal chips with compressed air.
6. Mark 1 in. pipe tap with a piece of tape 28 mm (1-1/8 in.) from end of tap.
7. Coat pipe tap with grease to aid in picking up metal chips.
8. Cut threads in access holes.
9. Stop cutting when the edge of the tape reaches the gimbal housing.





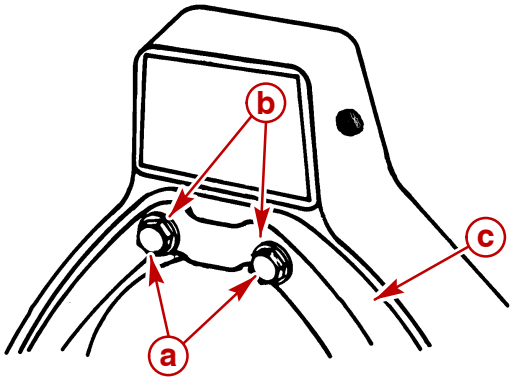
75904

a - Location of tape

Description	Part Number
Pipe tap, 1 in. NPT	Obtain locally

Gimbal Ring, Swivel Shaft, and Steering Lever Removal

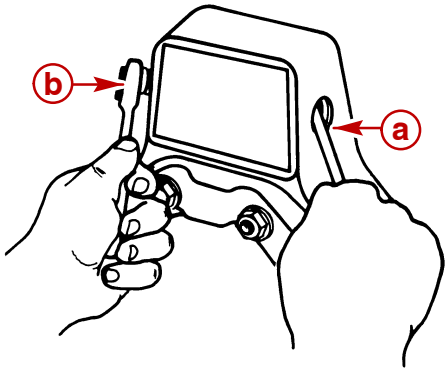
1. Loosen U-bolt nuts.



70150

a - U-bolt nuts (2)
b - Washers (4)
c - Gimbal ring

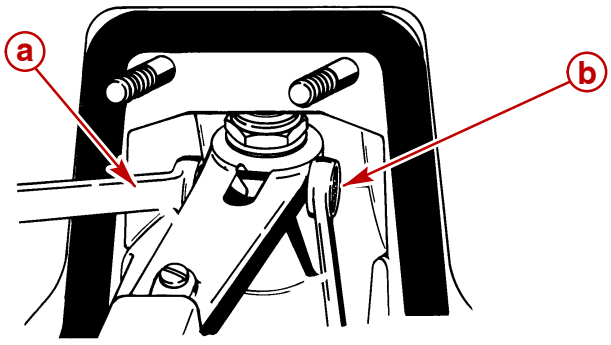
2. Loosen steering lever clamping bolt and nut.



70157

Engine and transom assembly installed

a - Wrench
b - Socket wrench

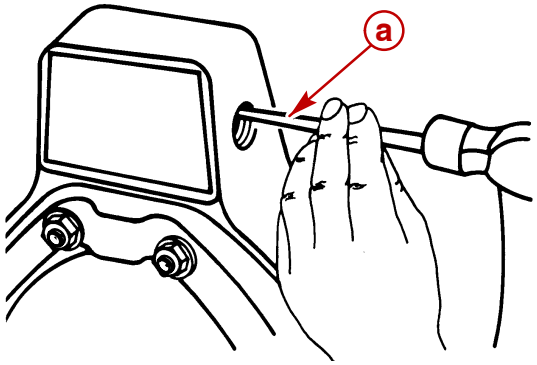


22460

Engine and transom assembly removed

a - Wrench
b - Wrench

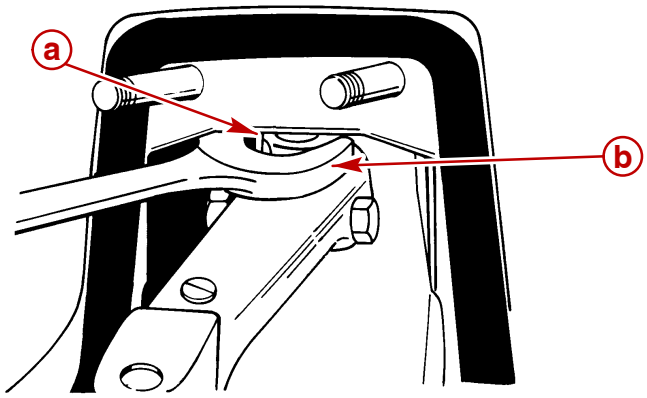
3. Remove locknut using pin punch to turn nut.



70156

Engine and transom assembly installed

a - Pin punch

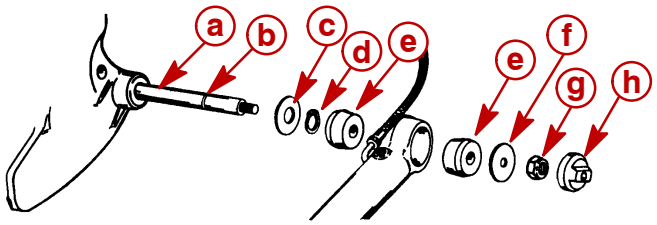


22452

Engine and transom assembly removed

a - Locknut
b - 1-1/16 in. wrench

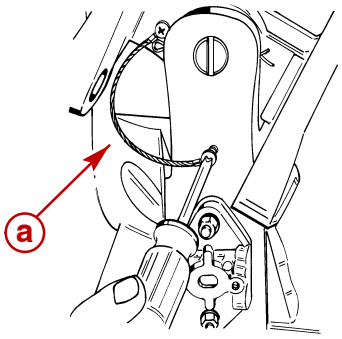
4. Disconnect trim cylinders from gimbal ring. Suspend cylinders to avoid damage to hoses.



71489

a - Anchor pin (1)
b - Slots (2)
c - Flat washer (large ID) (2)
d - Snap rings (2)
e - Bushings (4)
f - Flat washer (small ID) (2)
g - Locknut (2)
h - Plastic cap (2)

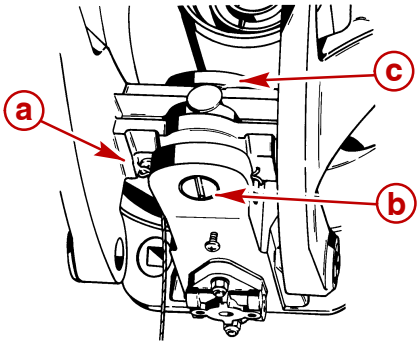
5. Disconnect continuity wire.



22261

a - Continuity wire

6. Remove cotter pin, lower swivel pin, and washer.

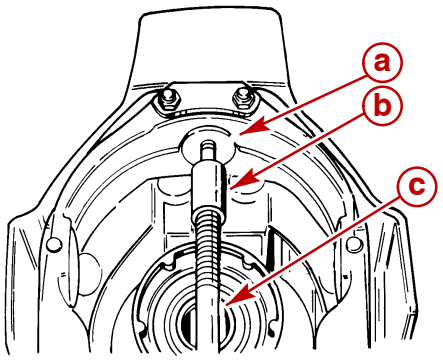


22461

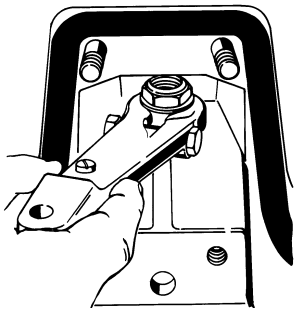
a - Cotter pin
b - Lower swivel pin
c - Washer

7. Remove large ID washer, steering lever, small ID washer, and locknut.

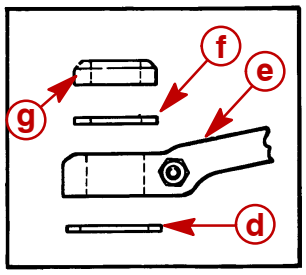
8. Remove upper swivel shaft from gimbal ring using Slide Hammer Puller and Puller Head.



76661

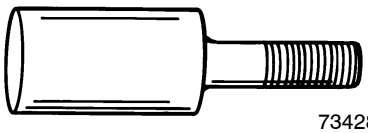


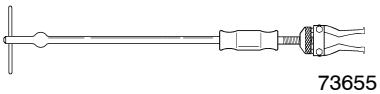
22463



22492

a - Swivel shaft
b - Puller Head
c - Slide Hammer Puller
d - Washer
e - Steering lever
f - Small ID washer
g - Locknut

Puller Head		
 73428	Removes hinge pin from the Bravo One, Bravo Two and Bravo Three High Performance sterndrive units.	91-63616T

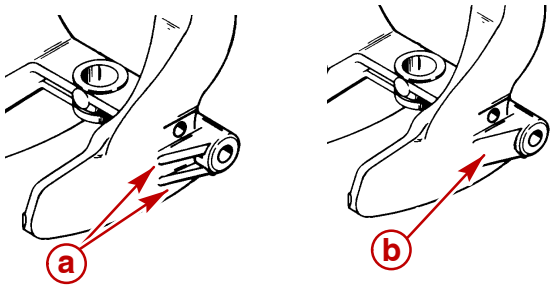
Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

9. Remove gimbal ring.

Gimbal Ring Servicing

Gimbal Ring Identification

The gimbal ring used on various model transom assemblies can be identified as shown in the following illustration.



75272

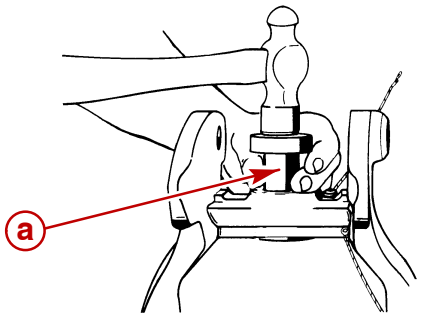
a - Standard gimbal ring identification (2 ribs)
b - Magnum and High Performance gimbal ring identification (filled area)

Bushing Removal

⚠ CAUTION

Be careful not to damage bores when removing self-lubricating bushings in the following steps.

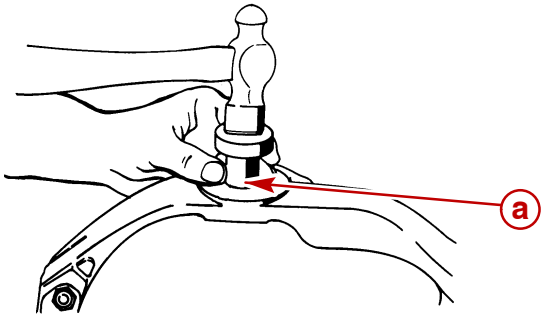
1. Tap out and remove gimbal ring lower swivel pin bushing using a suitable mandrel.



22451

a - Suitable mandrel

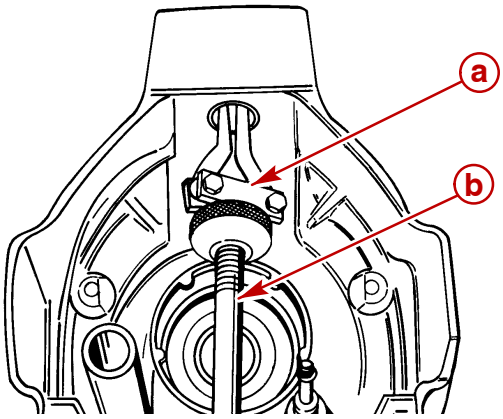
2. Remove gimbal ring hinge pin bushings (port and starboard) using a suitable mandrel.



22452

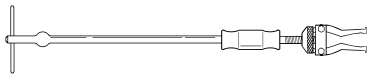
a - Suitable mandrel

3. Remove oil seal and large bushing from gimbal housing using a Two Jaw Puller and Slide Hammer.

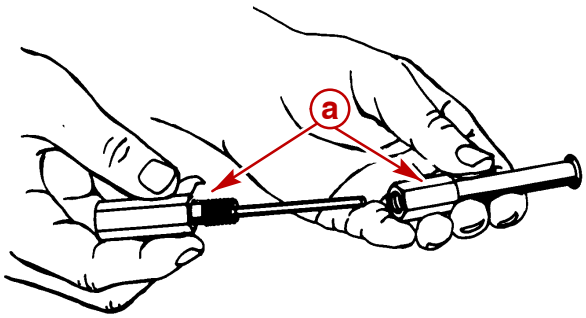


22452

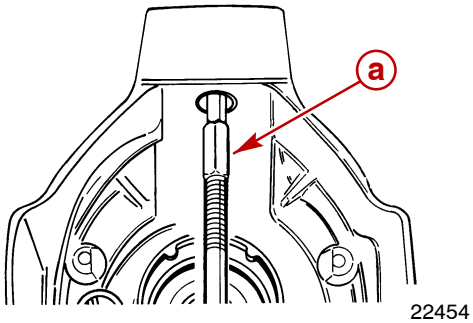
a - Two Jaw Puller
b - Slide Hammer

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement Jaw	91-34569A1

4. Remove small bushing from gimbal housing using a Bushing Removal Tool.



22438



22454

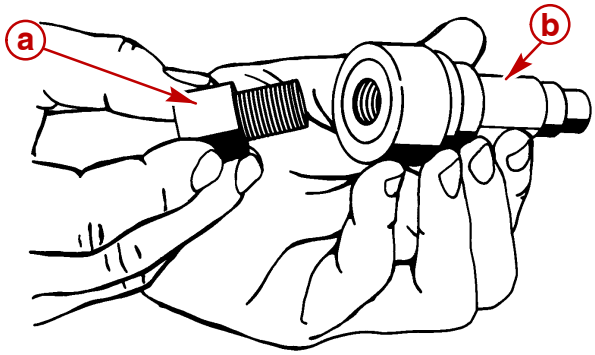
a - Bushing Removal Tool

Description	Part Number
Bushing Removal Tool	CG40CB

Install Bushings

1. Install gimbal ring hinge pin bushings as follows:

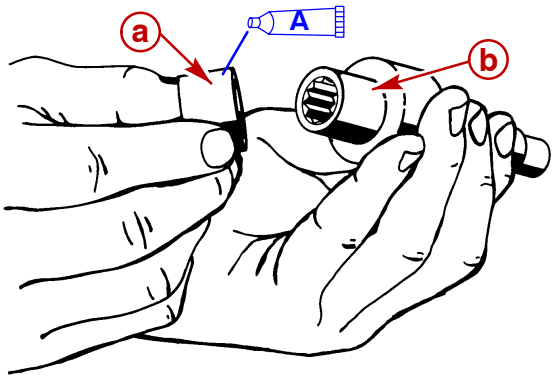
   a. Install hinge pin into Bearing And Seal Driver.



22452

a - Hinge pin
b - Bearing And Seal Driver

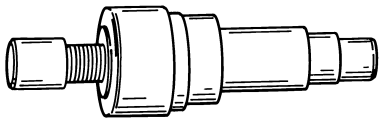
   b. Apply sealer to hinge pin bushing and position bushing on Bearing And Seal Driver.



22440

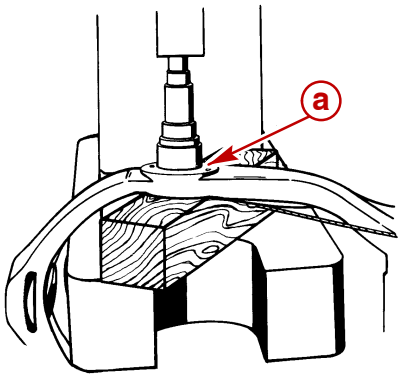
a - Hinge pin bushing
b - Bearing And Seal Driver

Description		Where Used	Part Number
A	Sealer Kit, Two Part Epoxy	Outer diameter of hinge pin bushing	92-65150-1

Bushing / Bearing / Seal Driver		
 73444	Installs the Bravo transom assembly bushings, bearings and seals.	91-43578A1

   c. Inspect bore for cleanliness and damage before installing bushing.

d. Install bushing in each side of gimbal ring by pressing in place.

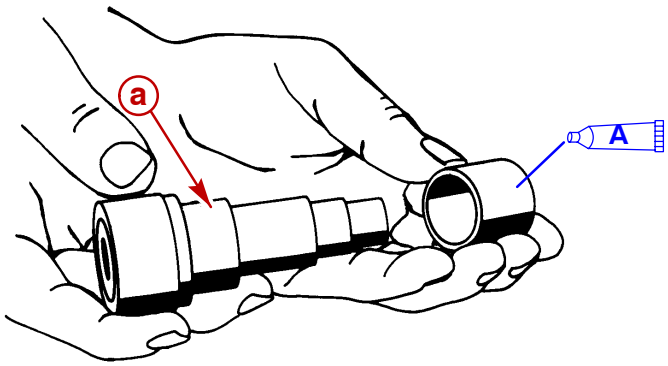


22454

a - Gimbal ring

2. Install gimbal ring lower swivel pin bushing.

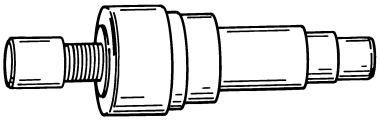
a. Apply sealer to outer diameter of bushing and position bushing on Bearing And Seal Driver.



22440

a - Bearing And Seal Driver

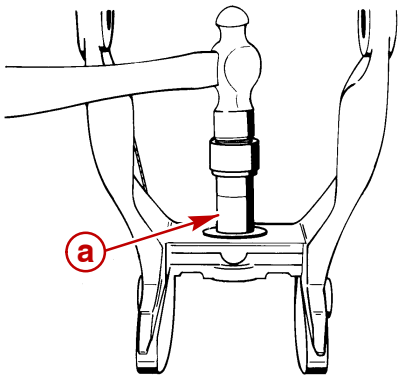
Description		Where Used	Part Number
A	Sealer Kit, Two Part Epoxy	Outer diameter of bushing	92-65150-1

Bushing / Bearing / Seal Driver		
 73444	Installs the Bravo transom assembly bushings, bearings and seals.	91-43578A1

b. Inspect bore for cleanliness and damage before installing bushing.

c. Install bushing in gimbal ring by pressing or tapping in place with a hammer.

NOTE: *Pressing is preferred. When using a hammer, install a used hinge pin in the driver to protect the threads.*

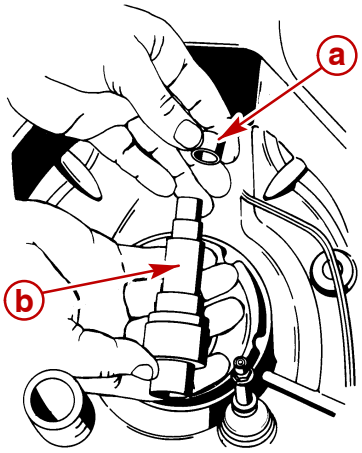


22453

a - Bushing

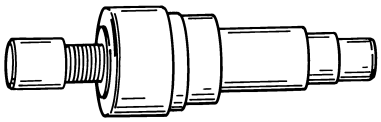
3. Install upper swivel shaft small bushing as follows:

a. Place bushing on Bearing And Seal Driver.

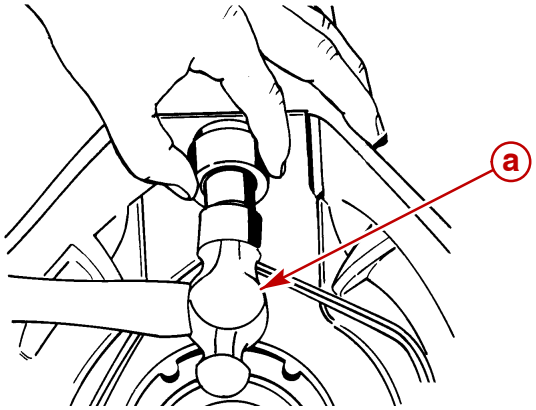


22440

a - Bushing
b - Bearing And Seal Driver

Bushing / Bearing / Seal Driver		
 73444	Installs the Bravo transom assembly bushings, bearings and seals.	91-43578A1

b. Install bushing by tapping it in place with a hammer.

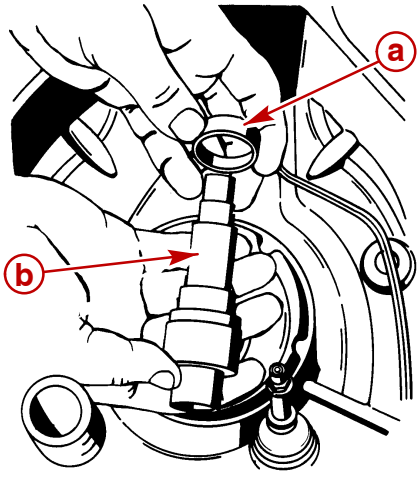


22450

a - Hammer

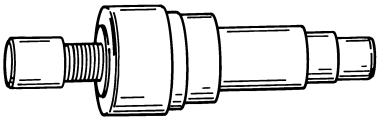
4. Install upper swivel shaft large bushing as follows:

a. Place bushing on Bearing And Seal Driver.

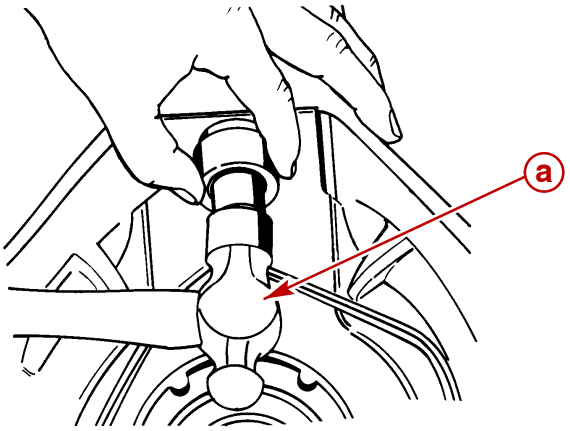


22436

a - Bushing
b - Bearing And Seal Driver

Bushing / **Bearing** / **Seal Driver**		
 73444	Installs the Bravo transom assembly bushings, bearings and seals.	91-43578A1

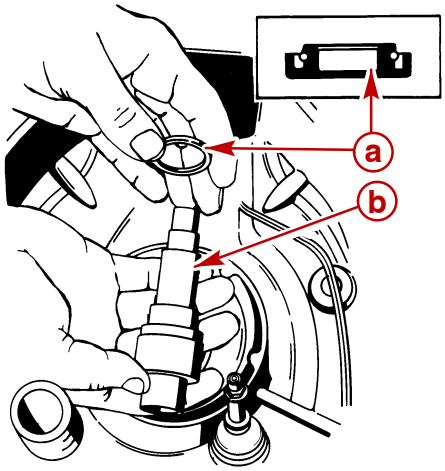
b. Install bushing by tapping it in place with a hammer.



22450

a - Hammer

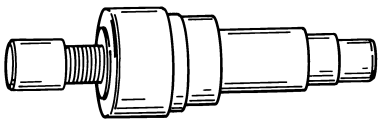
5. Install upper swivel shaft grease seal.
   a. Place seal on Bearing And Seal Driver with lip facing the small diameter end of tool.
   b. Apply sealant to seal.



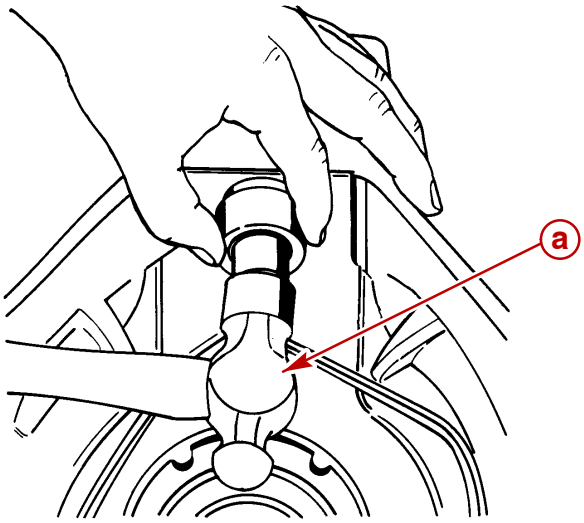
22440

a - Seal
b - Bearing And Seal Driver

Description	Where Used	Part Number
Loctite 271 Threadlocker	Outer diameter of seal	92-809819

Bushing / Bearing / Seal Driver		
 73444	Installs the Bravo transom assembly bushings, bearings and seals.	91-43578A1

c. Install grease seal by tapping it in place with a hammer.



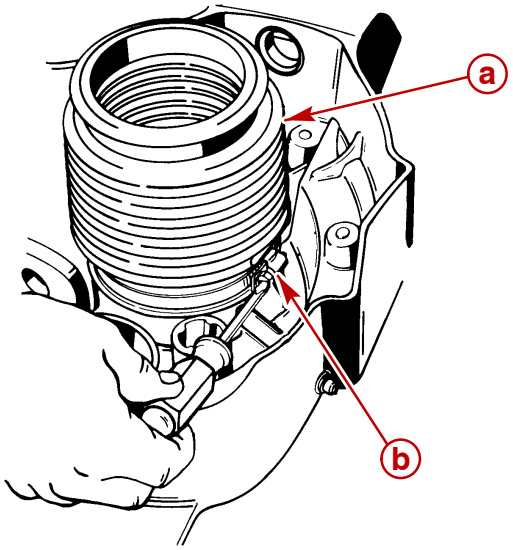
22450

a - Hammer

Gimbal Housing Servicing

U-joint Bellows Replacement

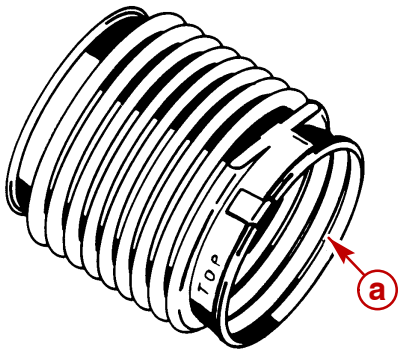
1. Remove U-joint bellows from gimbal housing.



50383

a - U-joint bellows
b - Hose clamp

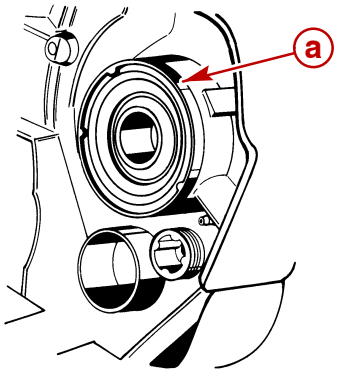
2. If reusing bellows, remove old adhesive from U-joint bellows using lacquer thinner.



50383

a - U-joint bellows

3. Clean bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.



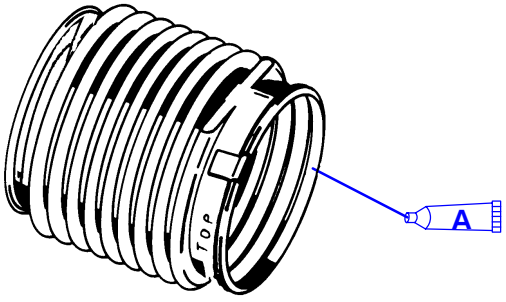
76662

a - Mounting flange

⚠ WARNING

Read and follow package label direction when using bellows adhesive.

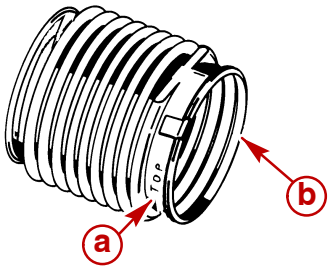
4. Apply adhesive to inside diameter of bellows end that will be attached to gimbal housing. Adhesive is not needed on the other end that connects to the bell housing. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.



50383

Description		Where Used	Part Number
A	Bellows Adhesive	Inside diameter of bellows end that attaches to gimbal housing	92-86166Q1

IMPORTANT: "TOP" mark on U-joint bellows must be facing upward when installing bellows.



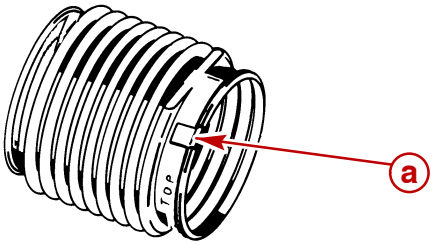
50383

a - "TOP" mark
b - Bead

⚠ CAUTION

Bellows clamp may corrode if ground clip is not installed.

5. Position ground clip on bellows.



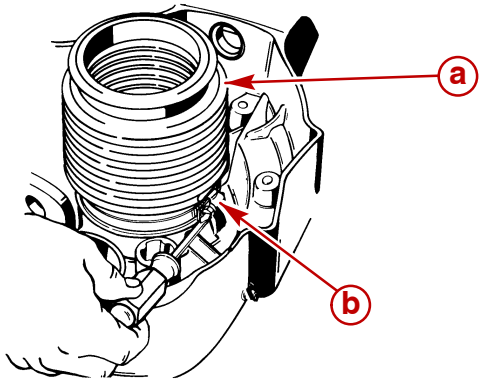
50383

a - Ground clip

6. Position U-joint bellows with "TOP" mark facing upwards and install U-joint bellows on gimbal housing flange and position clamp. Torque clamp.

Description	Nm	lb-in.	lb-ft
Bellows clamp	4	35	

IMPORTANT: Ensure that the bead on the inner mating surface of bellows is positioned in the groove in gimbal housing flange.

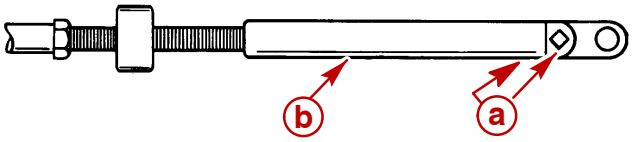


50383

a - U-joint bellows
b - Hose clamp

Shift Cable Bellows Replacement

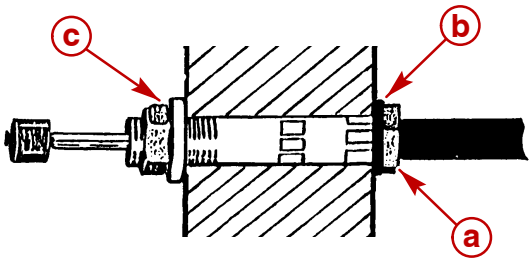
1. Remove shift cable.
   a. Disconnect shift cable from shift plate and remove end guide.



22183

a - Anchor screws (2)
b - End guide

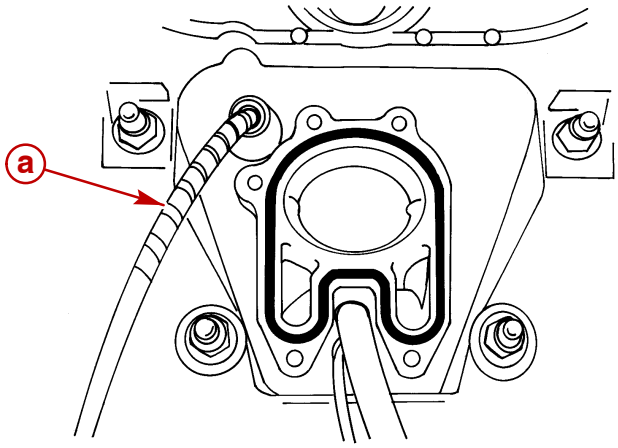
2. Remove flanged nut. Hold shift cable retaining nut with wrench.



76673

a - Shift cable retaining nut
b - Seal washer
c - Flanged nut

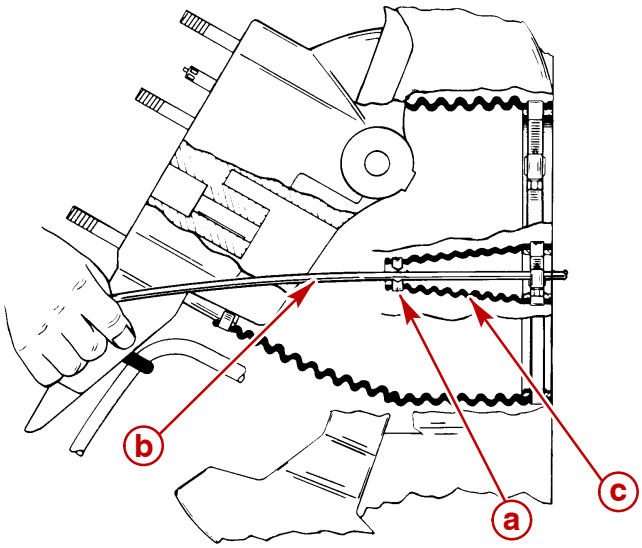
3. Remove shift cable wrapping.



76639

a - Shift cable wrapping

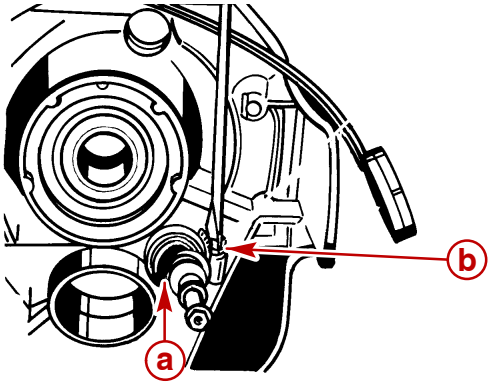
4. Loosen shift cable bellows crimp clamp and pull shift cable through shift cable bellows.



50458

a - Crimp clamp
b - Shift cable
c - Shift cable bellows

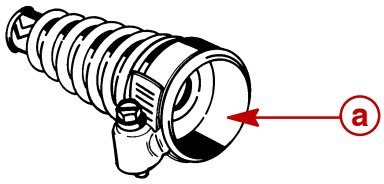
5. Remove shift cable bellows from gimbal housing.



76663

a - Shift cable bellow
b - Hose clamp

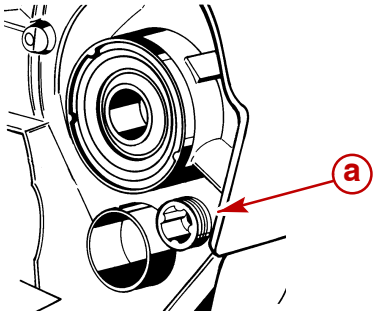
6. Remove old adhesive from shift cable bellows mounting surface using lacquer thinner.



22454

a - Shift cable bellows mounting surface

7. Clean shift cable bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.



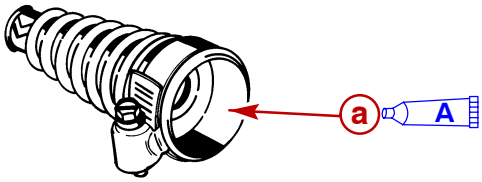
76662

a - Mounting flange

⚠ WARNING

Read and follow package label directions before using bellows adhesive.

8. Apply adhesive to shift cable bellows mounting surface. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.

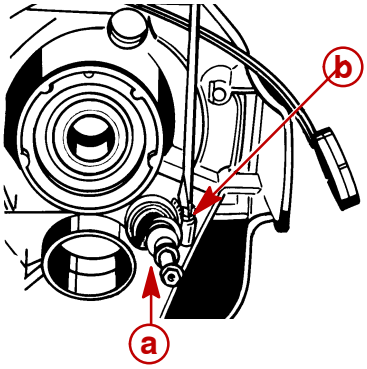


22454

a - Bellows mounting surface

Description		Where Used	Part Number
A	Bellows Adhesive	Shift cable bellows mounting surface	92-86166Q1

9. Install shift cable bellows on gimbal housing flange.
10. Position hose clamp as shown and torque.



76663

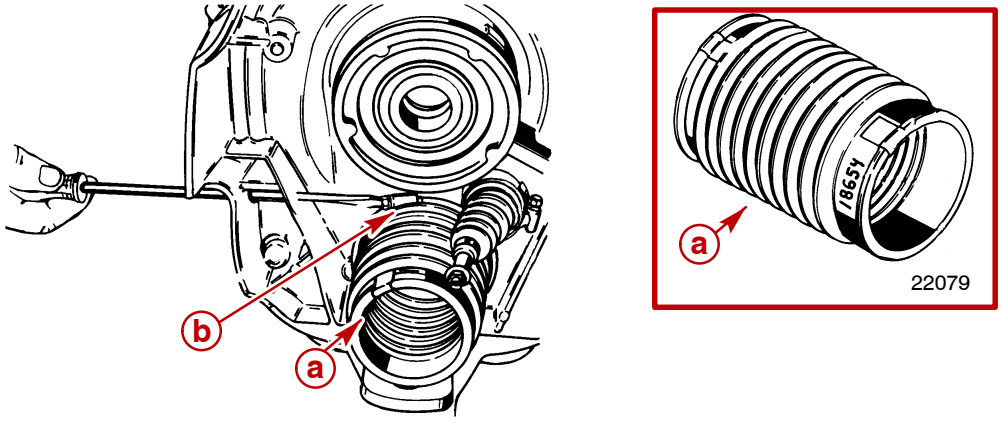
a - Shift cable bellows
b - Hose clamp

Description	Nm	lb-in.	lb-ft
Hose clamp on shift cable bellows	4	35	

Exhaust Bellows Replacement

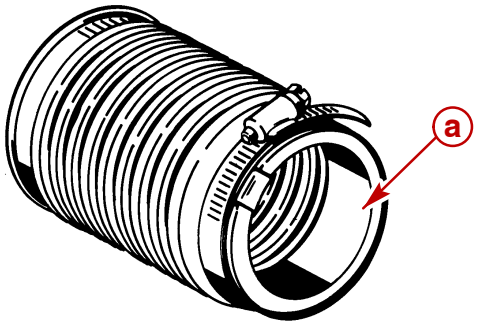
NOTE: *(For Exhaust Tube, refer to* ***Section 4A****)*

1. Remove exhaust bellows from gimbal housing.



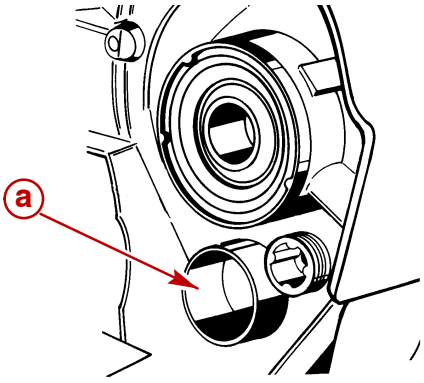
a - Exhaust bellows
b - Hose clamp

2. If old exhaust bellows will be reinstalled, remove old adhesive from exhaust bellows mounting surfaces with lacquer thinner.



a - Mounting surface

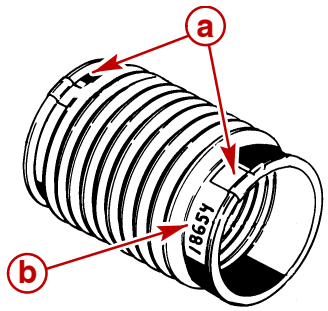
3. Clean exhaust bellows mounting flange with sandpaper and wipe clean with lacquer thinner.



a - Mounting flange

4. Position grounding clips on bellows.

IMPORTANT: Use bellows part number 18654A1 only. Do not substitute earlier model bellows.



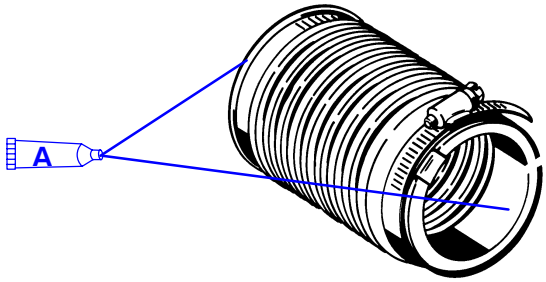
22079

a - Grounding clips
b - Part number

⚠ WARNING

Read and follow package label directions when using bellows adhesive.

5. Apply adhesive to exhaust bellows mounting surface. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.

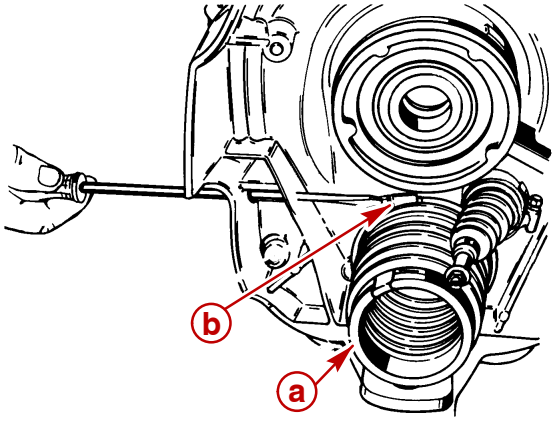


22450

Description		Where Used	Part Number
A	Bellows Adhesive	Exhaust bellows mounting surface	92-86166Q1

6. Install exhaust bellows on gimbal housing flange.

7. Position hose clamp as shown and torque.



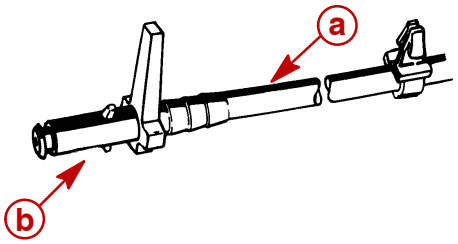
76660

a - Exhaust bellows
b - Hose clamp

Description	Nm	lb-in.	lb-ft
Hose clamp on exhaust bellows	4	35	

Speedometer Hose Replacement

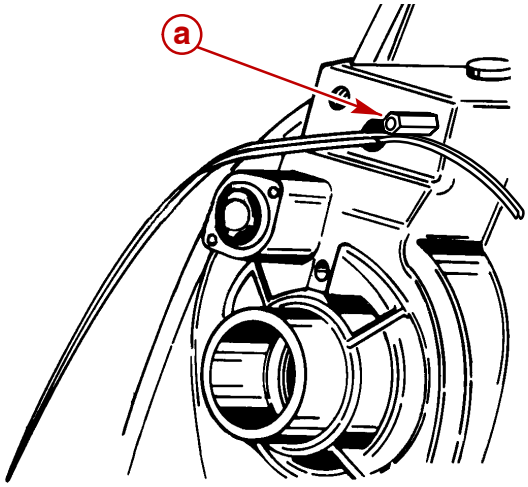
1. Remove hose from plastic adapter fitting.



22461

a - Hose
b - Plastic adapter fitting

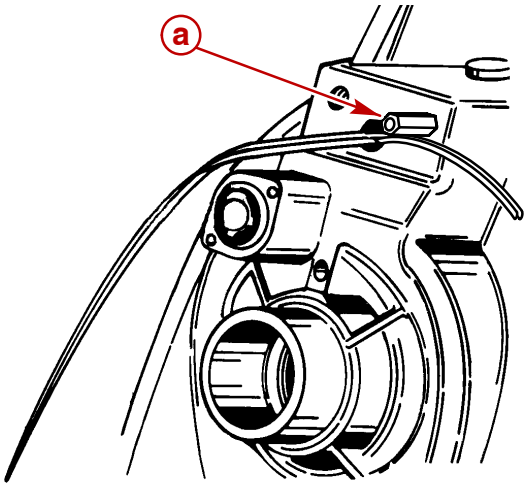
2. Remove hex fitting from inner transom and pull speedometer hose through transom.



76672

a - Hex fitting

3. Remove speedometer hose by removing clamp and pulling hose off.
4. Install inner new speedometer hose on barbed fitting. Secure with hose clamp.
5. Push speedometer hose through transom.
6. Install hex fitting and torque.

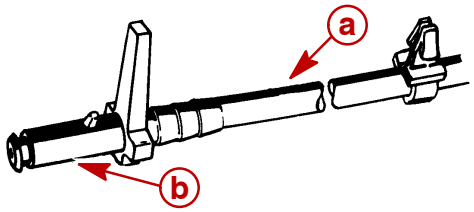


76672

a - Hex fitting

Description	Nm	lb-in.	lb-ft
Hex fitting	4	35	

7. Install plastic adapter fitting on speedometer hose.



22461

a - Hose
b - Plastic adapter fitting

Gear Lube Monitor System Components

MONITOR TO THROUGH BULKHEAD FITTING HOSE

Check hose periodically for condition and replace as necessary.

1. To replace hose, remove hose clamps and remove hose.
2. Install new hose of sufficient length to allow monitor to be removed from topside or bottom side of bracket. Secure hose with hose clamps.

NOTE: *If location does not require that the connecting hose crosses the inner transom plate to port side, the J-clip on water pickup outlet (top bolt) would be neither needed nor installed. The plastic hose clip can be used to hold hose in position, if needed, on transom and prevent it from contacting the power steering assembly or engine coupler after they are installed.*

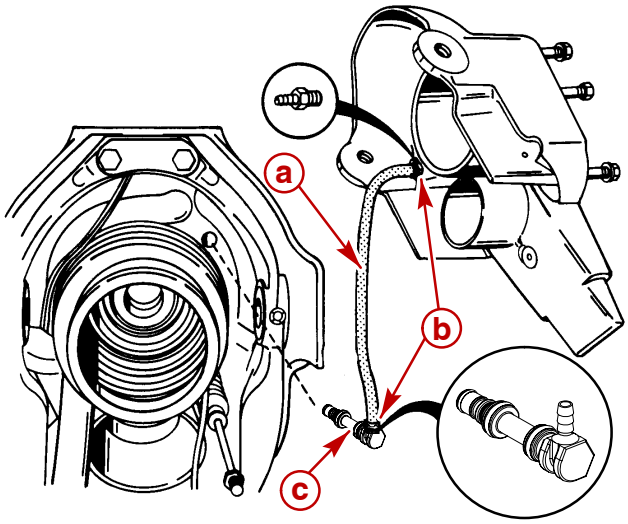
IMPORTANT: After installation of replacement hose, ensure that hose will not contact any part of the power steering assembly or engine coupler.

THROUGH BULKHEAD TO BELL HOUSING GEAR LUBE MONITOR HOSE

NOTE: *Bell housing must be removed from gimbal ring for this procedure. Refer* ***Section 4B - Bell Housing Removal****.*

1. Remove hose clamps.
2. Remove hose.
3. Replace hose and hose clamps.
4. Tighten hose clamps securely.

IMPORTANT: Hose and clamps are installed on bell housing hose barb and through bulkhead fitting, before through bulkhead fitting is reinstalled.



76664

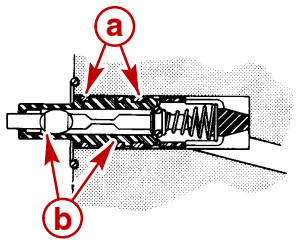
a - Hose - 25.4 cm (10 in.)
b - Hose clamps
c - Through bulkhead fitting

BELL HOUSING TO DRIVE SHAFT HOUSING CHECK VALVES

Unless damaged during disassembly or by heat, these check valves should last the life of the sterndrive unit.

The bell housing check valve is replaced as an assembly.

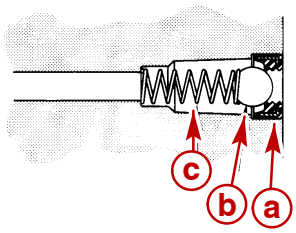
1. The bell housing check valve can be removed by pulling from casting with pliers.



50321

a - Check valve assembly
b - O-rings (2)

2. The seal cup, check ball, and spring can be removed by inserting a screw driver into the the center of the seal cup and prying it out while using a second screwdriver as a fulcrum.
   a. Remove the check ball and spring and discard if worn or defective.

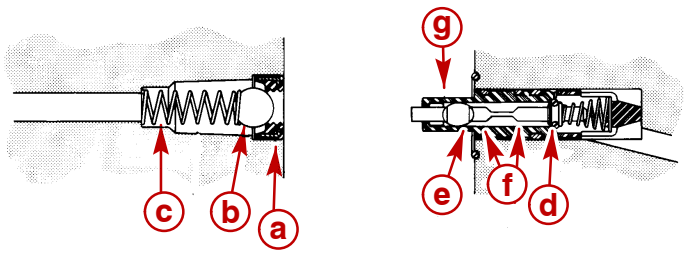


50321

a - Seal cup
b - Check ball
c - Spring

3. **Driveshaft Housing:** insert spring, check ball, and seal cup into casting. Press or tap carefully on seal cup until outer face is flush with casting surface. Do not use sealant.

4. **Bell Housing:** Lubricate O-rings.
   a. Insert check valve into seal cup.
   b. Using pliers, push check valve into casting until shoulder surface "**e**" is flush with casting surface.



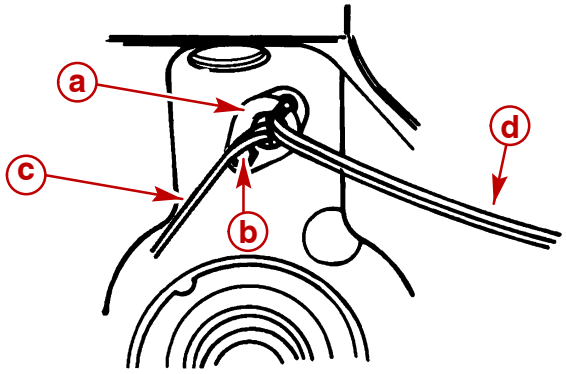
50321

a - Seal cup
b - Check ball
c - Spring
d - Bell housing check valve assembly
e - Surface flush with casting
f - O-rings (2)
g - Valve end

Description	Where Used	Part Number
High Performance Gear Lube	Check valve O-rings	92-802854A1

Trim Position Sender and Trim Limit Switch Wire Replacement

1. Remove trim harness clamp plate.

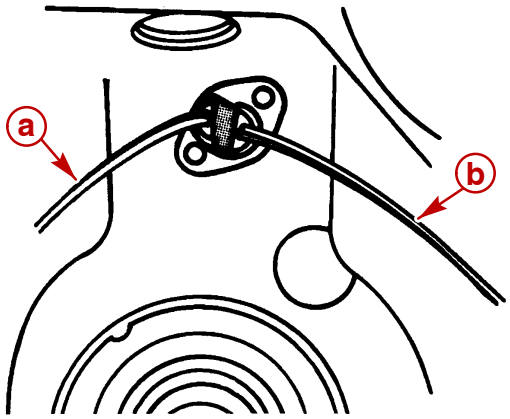


70197

a - Trim harness clamp plate
b - Screw
c - Trim limit switch wires
d - Trim position sender wires

2. Remove the trim position sender wires and the trim limit switch wires.

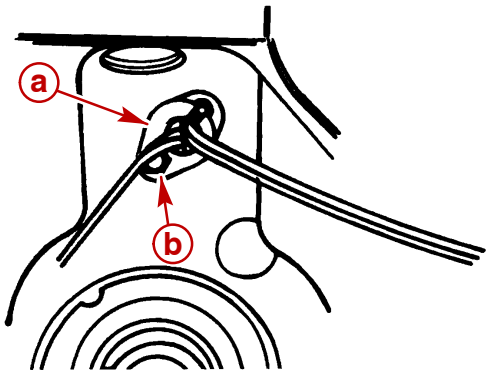
3. Install the new trim limit switch wires and trim position sender wires. Do not pinch wires.



70198

a - Trim limit switch wires
b - Trim position sender wires

4. Apply sealant to threads of screw and install trim harness clamp plate and screw.



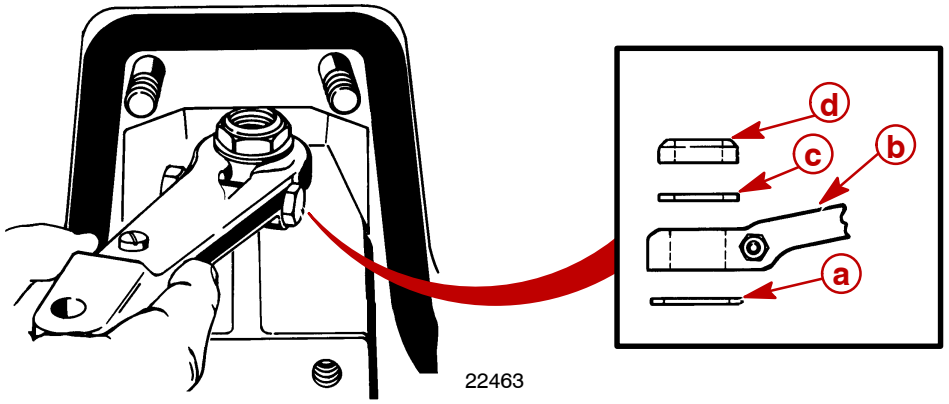
70197

a - Trim harness clamp plate
b - Screw

Description	Where Used	Part Number
Perfect Seal	Threads of screw	92-34227-1

Gimbal Ring / Swivel Shaft and Steering Lever Installation

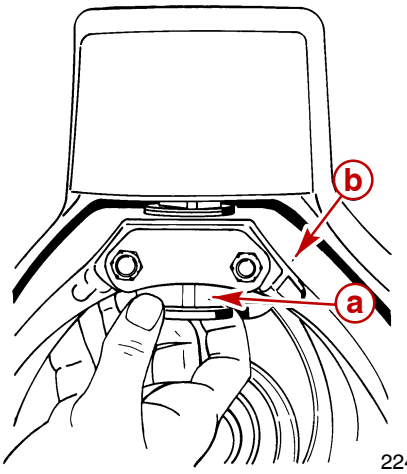
1. Place large inner diameter washer, steering lever, small inner diameter washer, and locknut into steering lever cavity in gimbal housing.



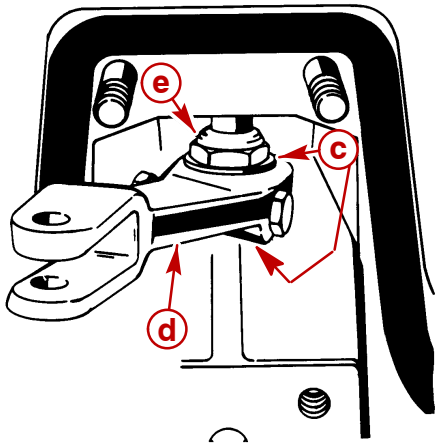
22463 22492

a - Large inner diameter washer
b - Steering lever
c - Small inner diameter washer
d - Locknut

2. Install upper swivel shaft through gimbal ring and up into and through the washers, steering lever, and locknut. Start locknut on upper swivel shaft threads. Do not tighten at this time.



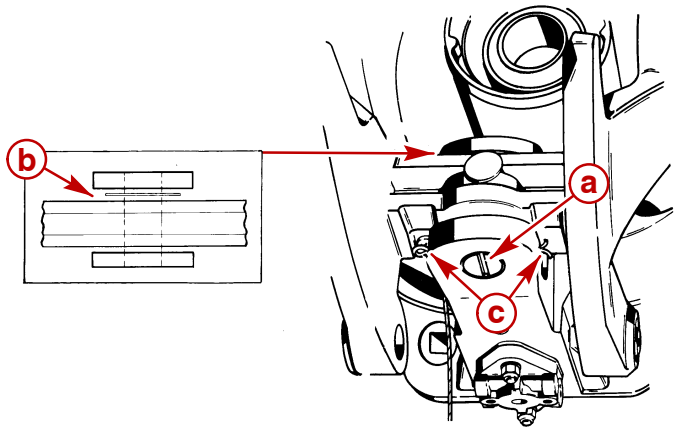
22452



22463

a - Upper swivel shaft
b - Gimbal ring
c - Washers
d - Steering lever
e - Locknut

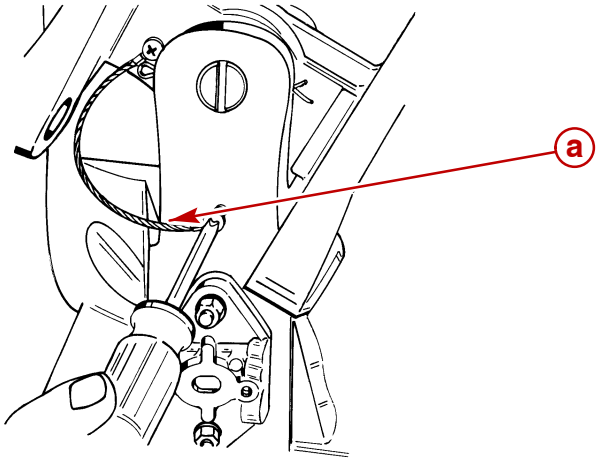
3. Align the hole in the lower swivel shaft with the hole in the gimbal housing.
4. Install lower swivel pin and washer. Secure with cotter pin and spread ends.



22461

a - Swivel pin
b - Washer
c - Cotter pin

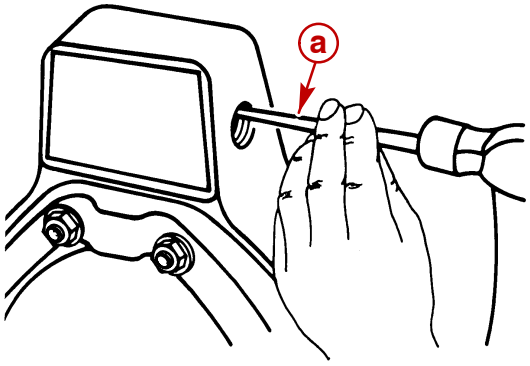
5. Clean ground wire ring terminal and screw.
6. Connect ground wire from gimbal housing to gimbal ring. Tighten securely.



22261

a - Ground wire

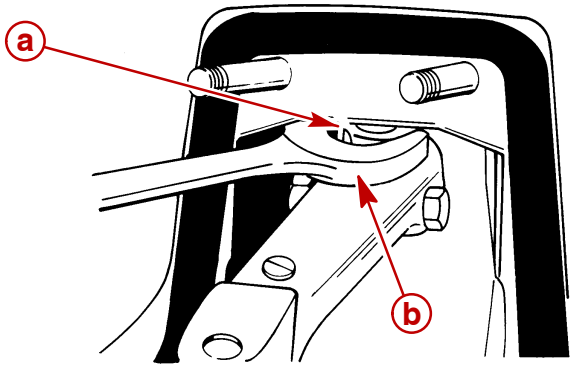
7. Tighten locknut until specified clearance exists between lower swivel pin washer and gimbal housing mount, using the pin punch to turn locknut.



70156

Engine and transom assembly installed

a - Pin punch



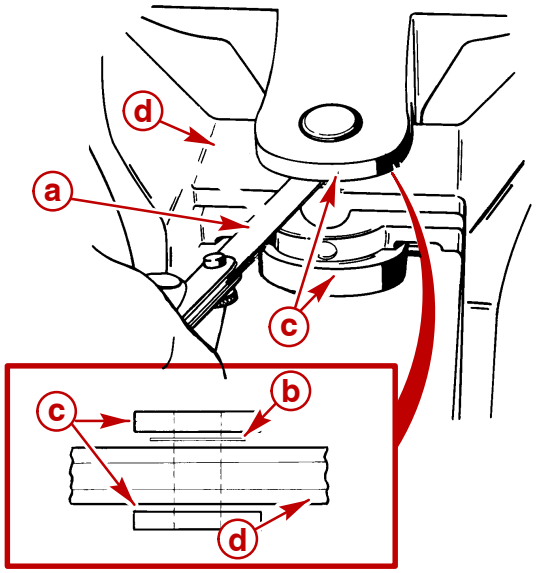
22452

Engine and transom assembly removed

a - Locknut
b - 1-1/16 in. wrench

Description	Specification
Clearance between lower swivel pin washer and gimbal housing mount	0.05-0.25 mm (0.002-0.010 in.)

8. Strike down on gimbal ring flanges using a plastic hammer.
9. Recheck clearance and tighten locknut as necessary.

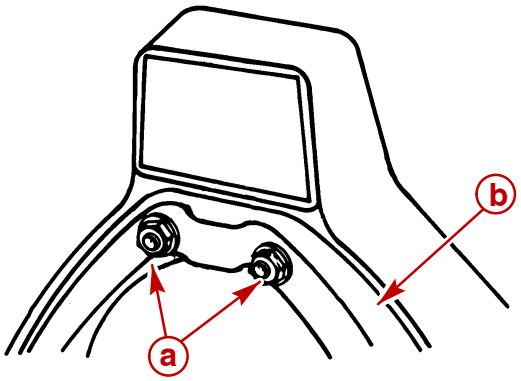


22461

22445

a - Feeler gauge - 0.05 - 0.25 mm (0.001 - .010 in.)
b - Washer
c - Gimbal housing mount
d - Gimbal ring

10. Torque locknuts evenly.

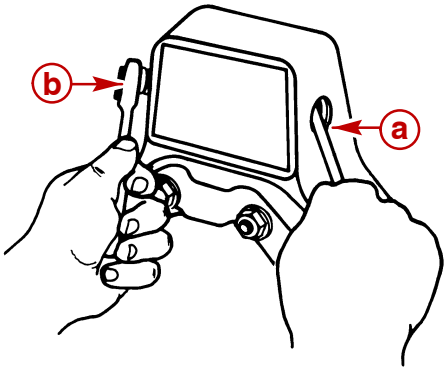


70150

a - Locknuts (2) and washers (2)
b - Gimbal ring

Description	Nm	lb-in.	lb-ft
Gimbal ring locknuts	72		53

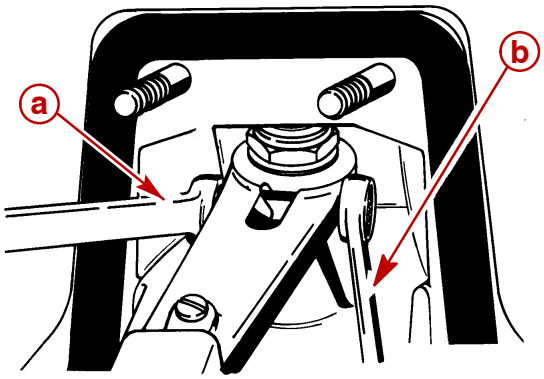
11. Tighten and torque steering lever clamping bolt and nut.



70157

Engine and transom assembly installed

a - Wrench
b - Socket wrench



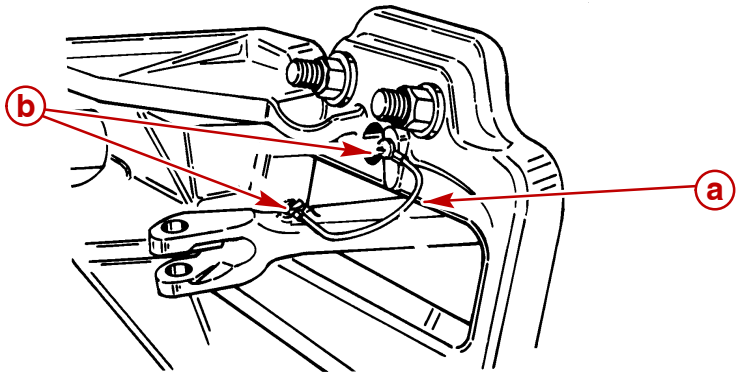
22460

Engine and transom assembly removed

a - Wrench
b - Wrench

Description	Nm	lb-in.	lb-ft
Steering lever clamping bolt and nut	68		50

12. Install steering lever ground wire. Wire must be positioned as shown. Tighten securely.

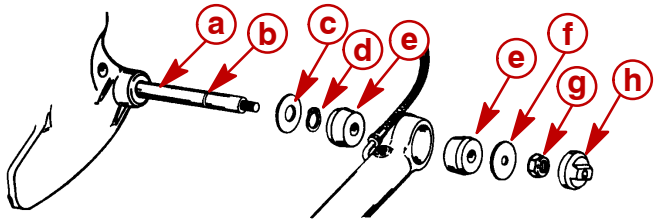


22028

a - Ground wire
b - Screws

13. Install anchor pin and snap rings.

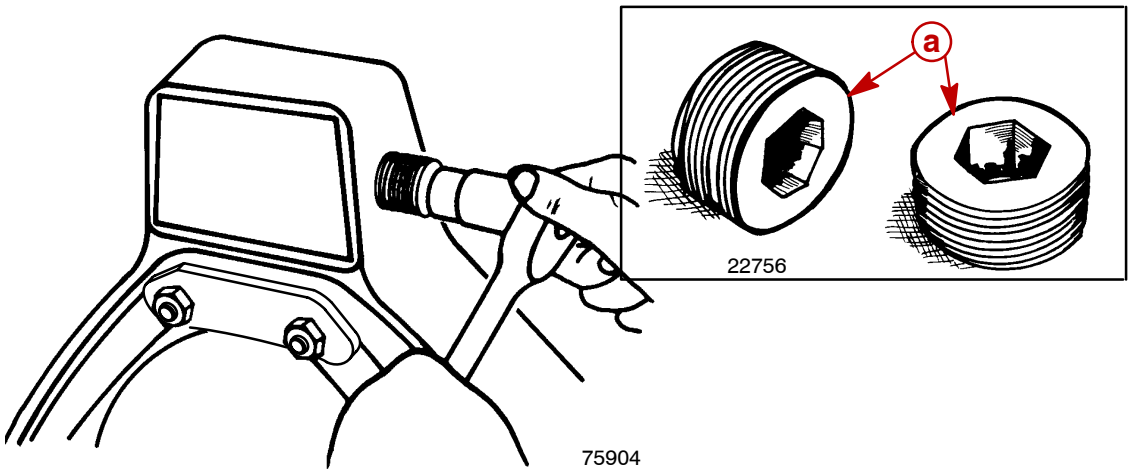
14. Install trim cylinders on gimbal ring.



71489

a - Anchor pin (1)
b - Slots (2)
c - Flat washer (large inner diameter) (2)
d - Snap rings (2)
e - Bushings (4)
f - Flat washer (small ID) (2)
g - Locknut (2)
h - Plastic cap (2)

15. Coat threads of plastic plugs (if used) with sealant and thread into access hole until flush with housing. Use a 5/8 in. hex wrench or 5/8 in. hex stock to secure.



a - Plastic plugs

Description	Where Used	Part Number
Perfect Seal	Threads of plastic plugs	92-34227-1

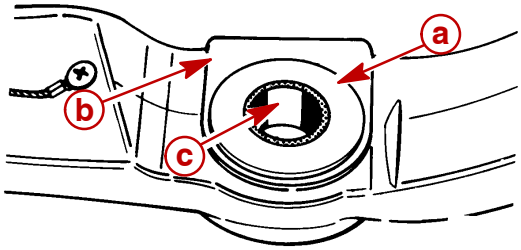
16. Touch up any bare metal spots with primer and Phantom Black spray paint.

Description	Where Used	Part Number
Phantom Black Spray Paint	Any bare metal spots	92-802878

Bell Housing Installation

Standard Transom Assembly

1. Install fiber washers on gimbal ring.
2. Secure with sealant.
3. Ensure that washer pilots on hinge pin bushing.



22454

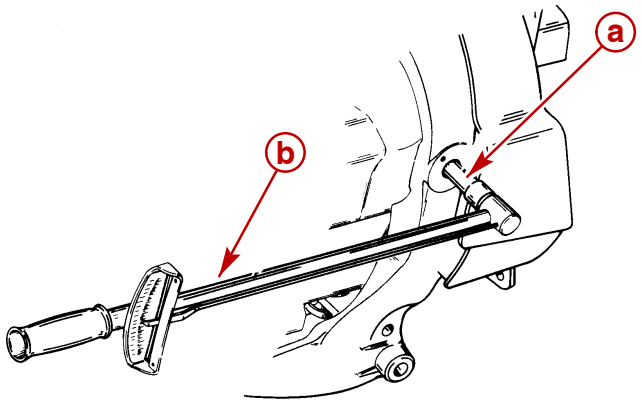
a - Fiber washers
b - Gimbal ring
c - Hinge pin bushing

Description	Where Used	Part Number
Resiweld Sealer	Secure fiber washers on gimbal ring	92-65150-1

4. Install bell housing.
5. Clean threads and apply sealant to threads of hinge pins (port and starboard).

Description	Where Used	Part Number
Loctite 271 Threadlocker	Threads of hinge pins	92-809819

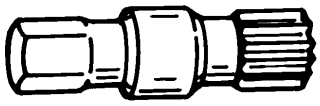
6. Install port and starboard hinge pins and torque.



22113

a - Hinge Pin Tool
b - Torque wrench

Description	Nm	lb-in.	lb-ft
Bell housing hinge pins	197		145

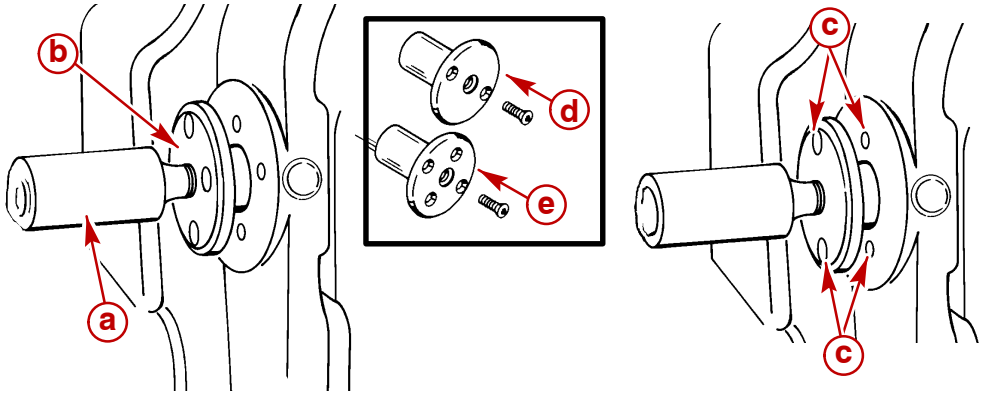
Hinge Pin Tool		
 73443	Installs and removes the hinge pins from all Mercury MerCruiser sterndrive units.	91-78310

High Performance Transom Assembly

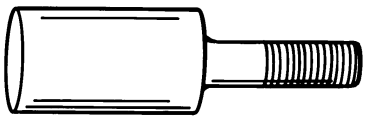
1. Install port and starboard hinge pins using Puller Head.
   a. Thread Puller Head into hinge pin.
   b. Lubricate hinge pin.

Description	Where Used	Part Number
Special Lubricant 101	Hinge pin	92-802865Q 1

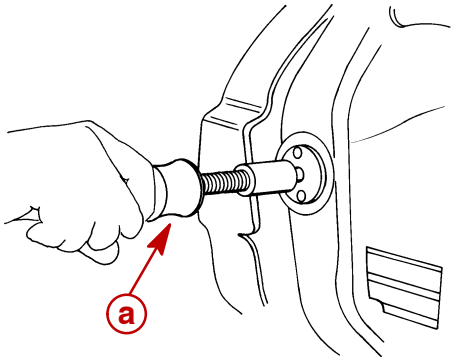
   c. Slide hinge pin through gimbal ring and bell housing.
   d. Align the screw holes in hinge pin with the screw holes in gimbal ring.

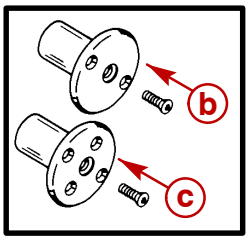


a - Puller Head
b - Hinge pin
c - Screw holes
d - High Performance hinge pin early style (2 screws)
e - High Performance hinge pin later style (4 screws)

Puller Head		
 73428	Removes hinge pin from the Bravo One, Bravo Two and Bravo Three High Performance sterndrive units.	91-63616T

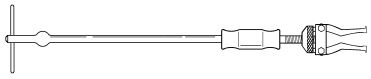
2. Lightly tap hinge pin into place using Slide Hammer.





71826

a - Slide Hammer
b - High Performance hinge pin early style (2 screws)
c - High Performance hinge pin later style (4 screws)

Slide Hammer Puller		
 73655	Removes the bearings and bearing cups. 91-34570 Replacement jaw	91-34569A1

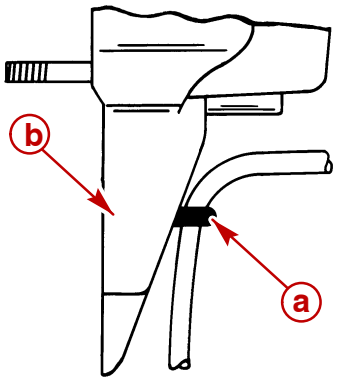
3. Apply sealant to threads of screws and install.
4. Torque the hinge pin screws.

Description	Where Used	Part Number
Loctite 242 Threadlocker	Threads of screw	Obtain locally

Description	Nm	lb-in.	lb-ft
High performance hinge pin screws (2) early style	203		150
High performance hinge pin screws (4) later style	3	27	

Standard And High Performance Transom Assemblies

1. Install speedometer hose clip onto bell housing.



22121

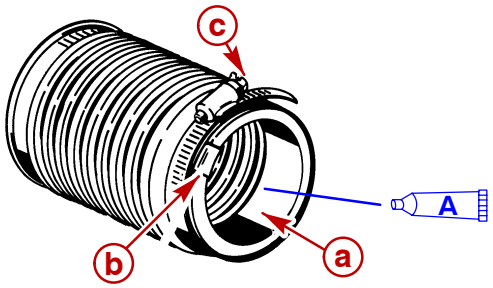
a - Speedometer hose clip
b - Bell housing

2. Clean exhaust bellows mounting flange on bell housing with sandpaper and wipe clean with lacquer thinner.

⚠ WARNING

Read and follow package label directions when using bellows adhesive.

3. Apply adhesive to exhaust bellows mounting surface. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.
4. Position grounding clip on bellows.
5. Place hose clamp over bellows end.

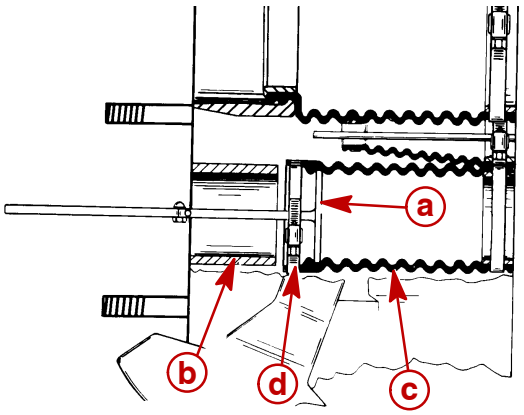


22450

a - Mounting surface
b - Grounding clip
c - Hose clamp

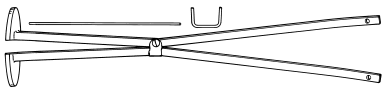
Description		Where Used	Part Number
A	Bellows Adhesive	Mounting surface on inside of bellows	92-86166Q1

6. Place Bellows Expander Tool into first bellows convolution.
7. Pull tool until tool touches the mounting flange on bell housing (bellows starts to slip onto flange) then release tool.



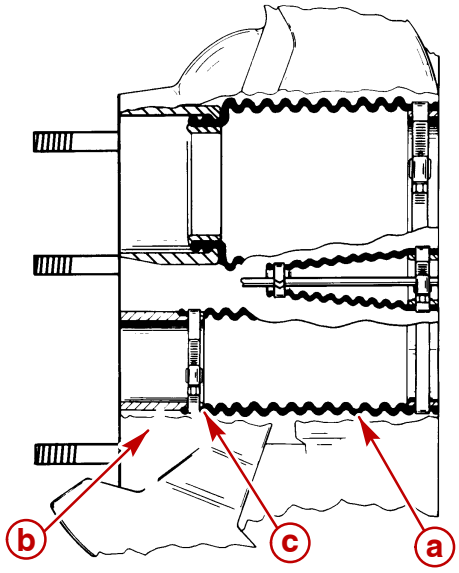
22116

a - Bellows Expander Tool
b - Bell housing flange
c - Exhaust bellows
d - Hose clamp

Bellows Expander Tool		
 73430	Installs the exhaust bellows on the Bravo One, Bravo Two transom units.	91-45497A1

8. Reposition tool into the third bellows convolution.
9. Pull bellows onto bell housing flange.

10. Tighten hose clamp and torque.
11. Remove tool.

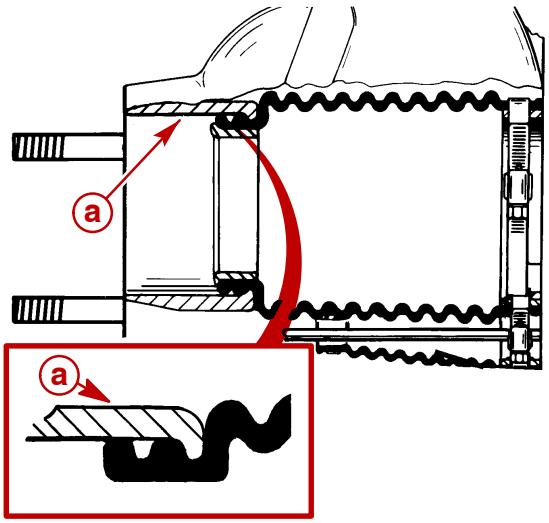


22116

a - Exhaust bellows
b - Bell housing flange
c - Hose clamp

Description	Nm	lb-in.	lb-ft
Exhaust bellows hose clamp	4	35	

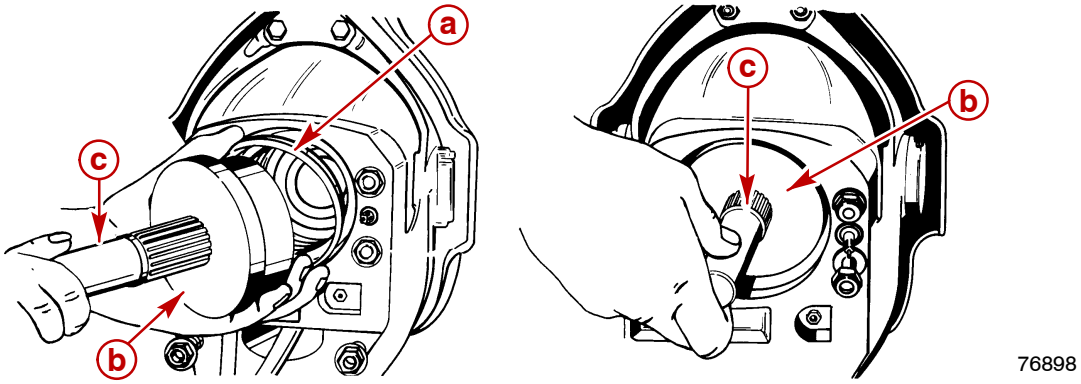
12. Position U-joint bellows on bell housing. Ensure that the bell housing flange rests in the second groove from the end of bellows.



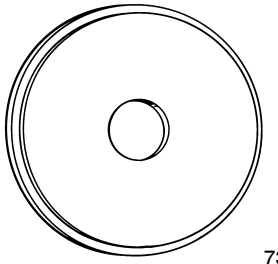
22116

a - Bell housing flange

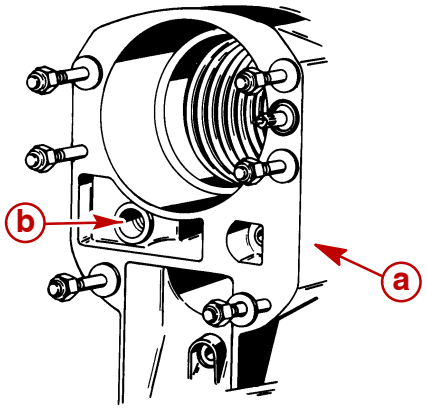
13. Lubricate sleeve outer diameter with soapy water or engine cleaner and install Sleeve Installation Tool and a suitable driving rod.



a - Sleeve
b - Sleeve Installation Tool
c - Suitable driving rod

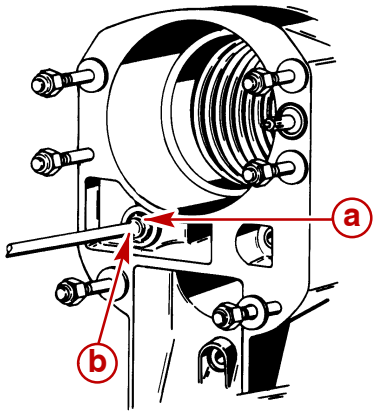
Sleeve Installation Tool		
 73485	Installs the aluminum sleeve in the U-joint bellows of all the Bravo transom units.	91-818162

14. Position water hose so that approximately 3 mm (1/8 in.) protrudes from edge of bell housing opening.



a - Bell housing
b - Water hose

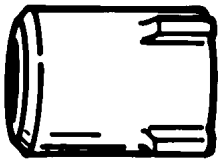
a. Apply a small amount of lubricant to hose inner diameter and install tapered inserts using the Tapered Insert Tool.



50322

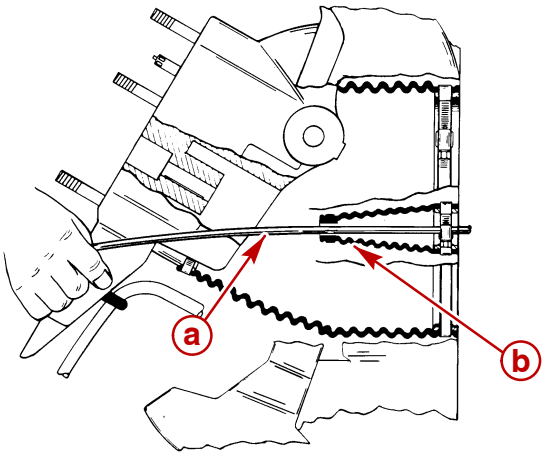
a - Tapered insert
b - Tapered Insert Tool

Description	Where Used	Part Number
2-4-C with Teflon	Hose inner diameter	92-802859A1

Tapered Insert Tool		
 73456	Installs and removes the tapered insert retainer into the water inlet hose on all the Bravo transom units.	91-43579

Shift Cable Installation

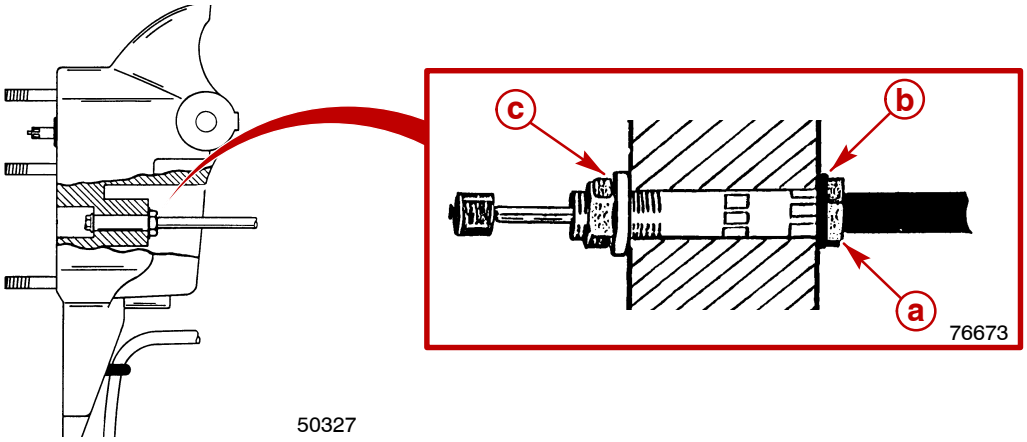
1. Insert shift cable end into and through shift cable bellows.



76620

a - Shift cable end
b - Shift bellows

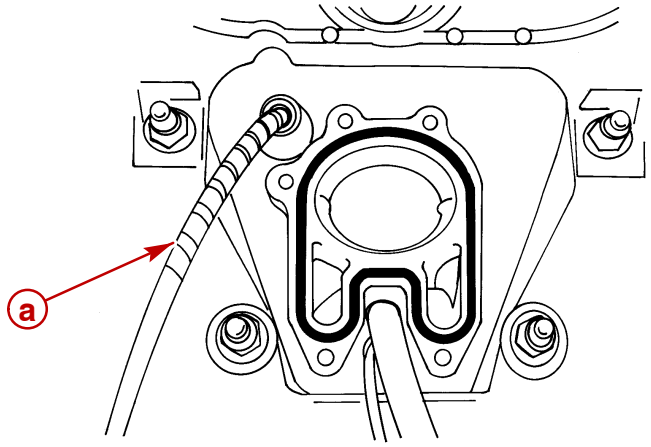
2. Apply sealant to shift cable retaining nut threads.
3. Secure shift cable to bell housing.



a - Shift cable retaining nut
b - Seal washer
c - Flanged nut

Description	Where Used	Part Number
Perfect Seal	Shift cable retaining nut threads	92-34227-1

4. Install shift cable wrapping approximately 51 mm (2 in.) from gimbal housing.



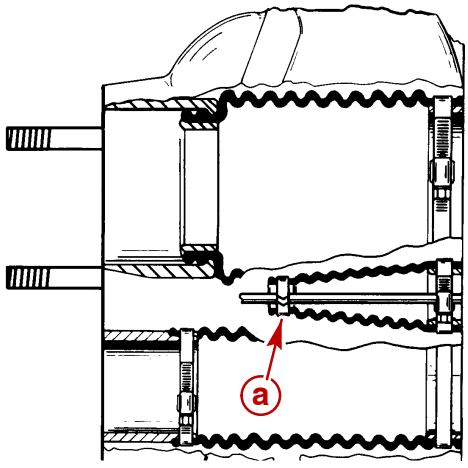
76639

a - Shift cable wrapping

⚠ CAUTION

Water leakage may result if clamp is not installed properly. Ensure that bellows end is not flattened out when crimping in the followlng step.

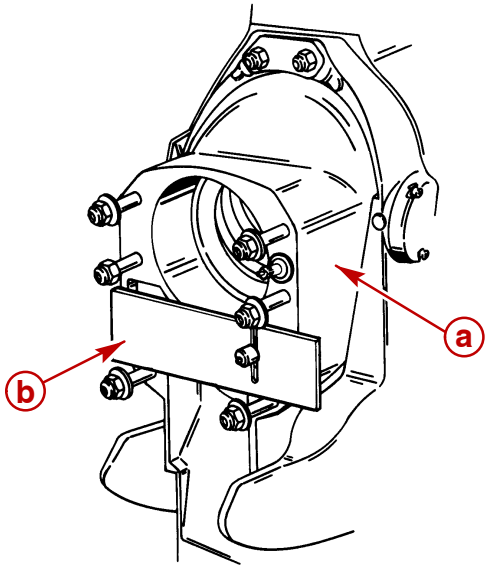
5. Install and compress shift cable bellows crimp clamp, maintaining a 13 mm (1/2 in.) diameter round outer diameter.
6. Ensure that clamp is crimped evenly to maintain a good seal between bellows and shift cable. Do not allow bellows to flatten. (Plans for Crimp Clamp Tool are at the end of **Section 4B**).



22117

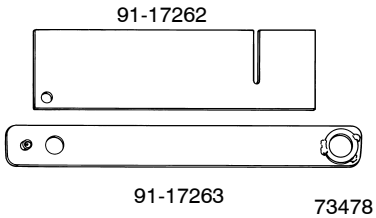
a - Crimp clamp

7. Install Core Wire Locating Tool on face of bell housing.

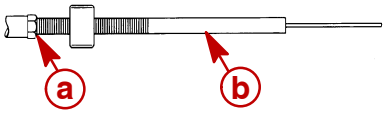


50327

a - Bell housing
b - Core Wire Locating Tool

Shift Cable Anchor Adjustment Tool		
 73478	Used when installing the shift cable in all Bravo Transom units. 91-17263 Core Wire Locating Tool 91-17262 Shift Cable Anchor Adjustment Tool	91-17262A1

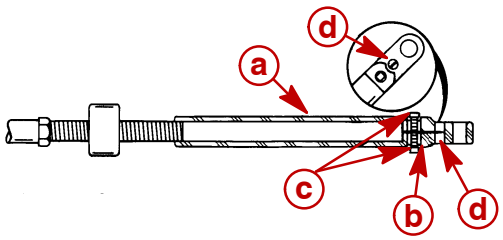
8. Install threaded tube until it contacts. Tighten finger-tight.
9. Tighten jam nut securely.



22183

a - Threaded tube
b - Jam nut

10. Install cable end guide over core wire and insert core wire through cable anchor. Tighten anchor screws evenly and torque.

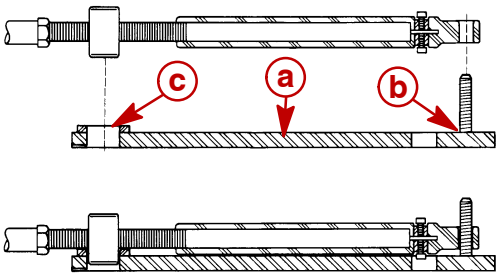


22183

a - Cable end guide
b - Core wire
c - Anchor screws
d - Sight port

Description	Nm	lb-in.	lb-ft
Anchor screws	2.3	20	

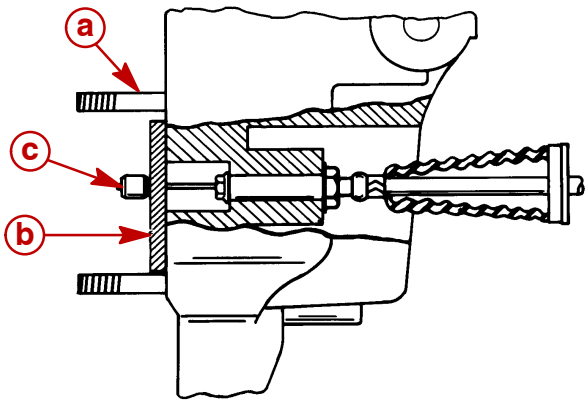
11. Place shift cable anchor adjustment tool on end of shift cable.



22120

a - Shift cable anchor adjustment tool
b - Stud
c - Hole - (barrel placed here)

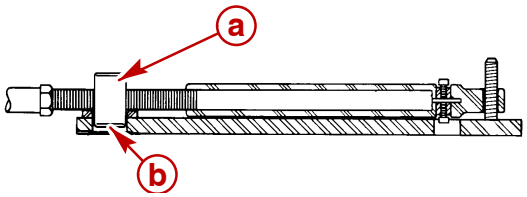
12. Ensure that bell housing end of core wire is positioned tight against Core Wire Locating Tool.



22121

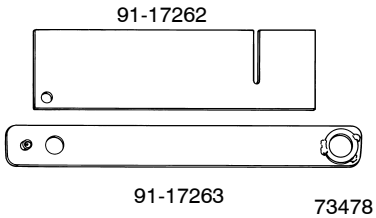
a - Bell housing
b - Core Wire Locating Tool
c - Core wire

13. Adjust cable barrel to align with hole in tool.

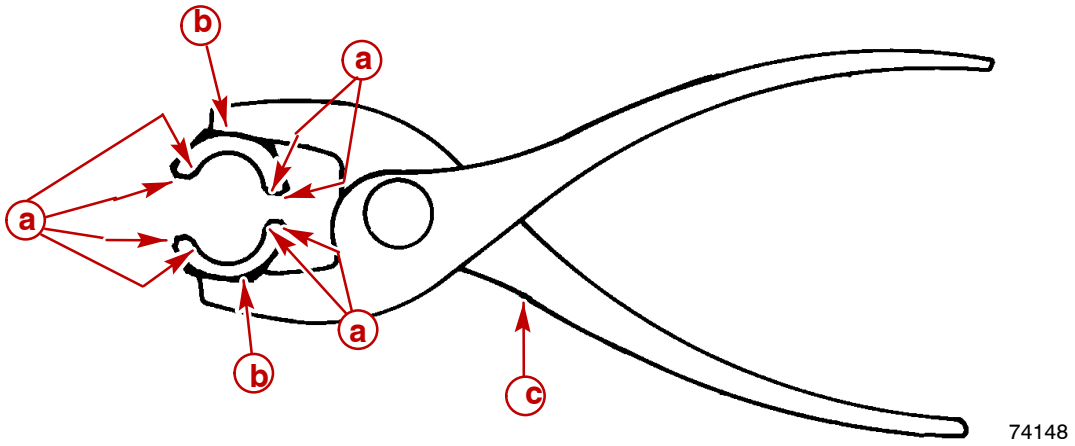


22120

a - Barrel
b - Hole in tool

Shift Cable Anchor Adjustment Tool		
 73478	Used when installing the shift cable in all Bravo Transoms units. 91-17263 Core Wire Locating Tool 91-17262 Shift Cable Anchor Adjustment Tool	91-17262A1

Crimp Clamp Tool



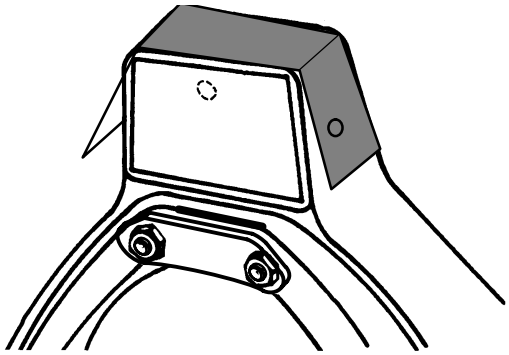
74148

a - Bevel edges
b - 3/4 in. nut
c - Pliers

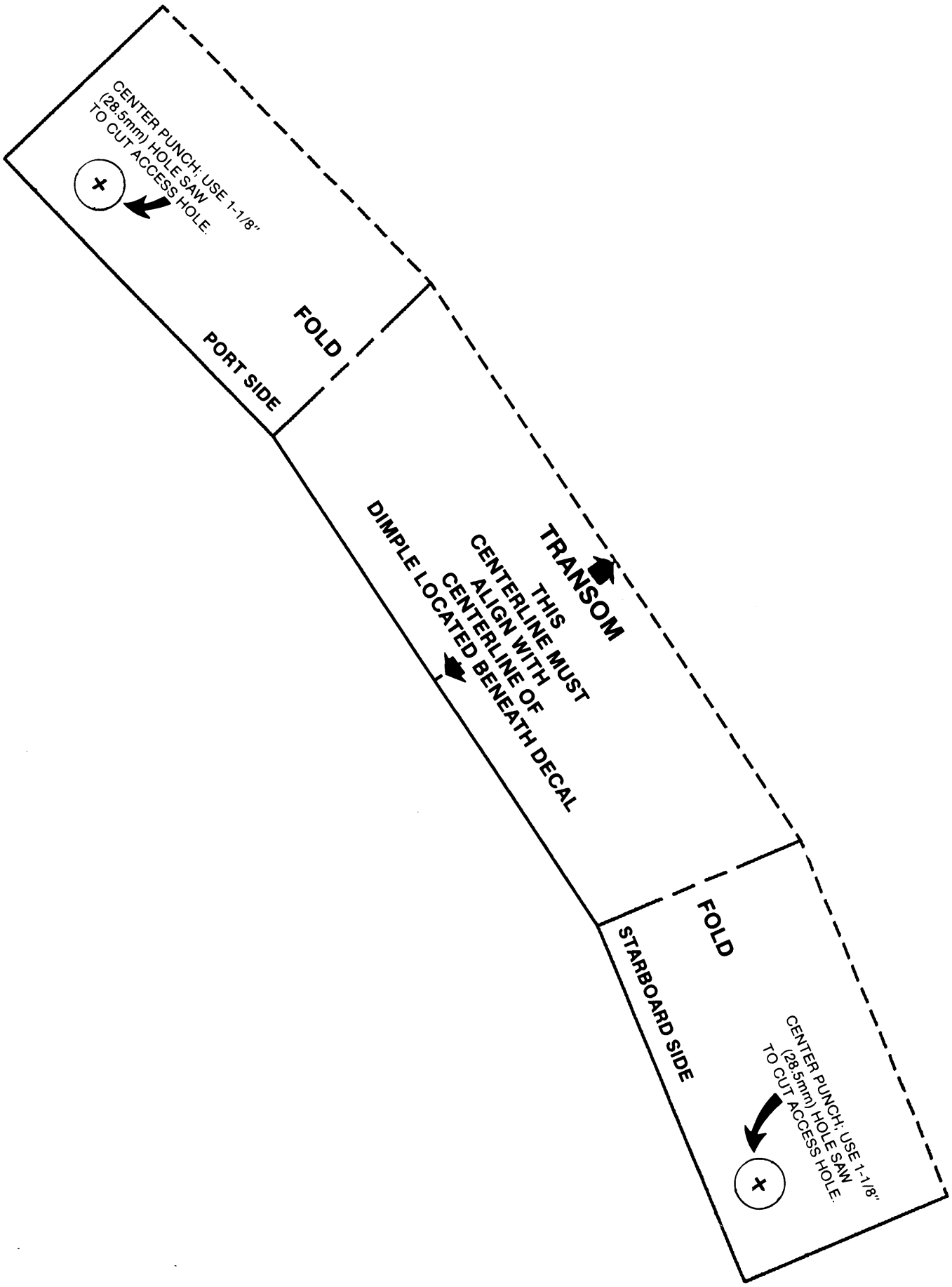
1. Weld a 3/4 in. nut to the jaws of a pair of pliers (as shown).
2. Saw the nut in half without damaging the pliers.
3. Clamp the jaws of the pliers in a vice so that the two halves of the nut are pressed firmly together.
4. Use a 1/2 in. drill bit to drill the threads out of the nut.
5. Remove the pliers from the clamp and bevel the edges of the nut .

Bravo Access Plug Drilling Template

IMPORTANT: Carefully cut out template - use straightedge to make accurate folds. Align centerline of template with centerline of dimple or grease fitting (on older models). With template accurately aligned, securely TAPE TEMPLATE TO GIMBAL HOUSING so that it cannot move or shift.



76628


CENTER PUNCH; USE 1-1/8" (28.5mm) HOLE SAW TO CUT ACCESS HOLE.
FOLD
PORT SIDE
TRANSOM
THIS CENTERLINE MUST ALIGN WITH CENTERLINE OF DIMPLE LOCATED BENEATH DECAL
FOLD
STARBOARD SIDE
CENTER PUNCH; USE 1-1/8" (28.5mm) HOLE SAW TO CUT ACCESS HOLE.

POWER TRIM

Section 5A - Oildyne Trim Pump

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5 A

Specifications

Valve Pressure Specifications

Description		kPa	psi
Valve	UP circuit	15173-17932	2200-2600
	DOWN circuit	2759-4138	400-600

Electrical Specification

Description		kPa	psi
Pump Amperage Draw	115 amps at:	15173-17932	2200-2600

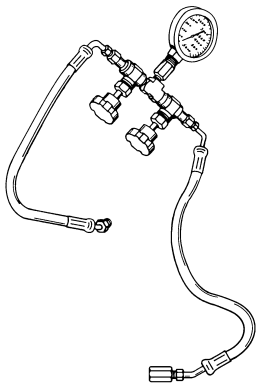
Torque Specification

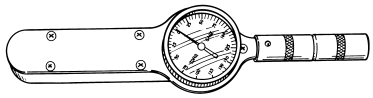
Description	Nm	lb-in.	lb-ft
Up pressure relief valve	7.9	70	
Down pressure relief valve	7.9	70	
Thermal relief valve	7.9	70	
Pump to adapter mounting screws	7.9	70	
Pump screws	8	75	
Adapter to reservoir screws (early model)	3	27	
Trim motor screws	2.8	25	
Hydraulic hose fittings	9	80	
Hydraulic hose adapter fittings	9	80	
Trim cylinder hoses	11	100	

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
Power Trim and Steering Fluid	Valve body O-rings	92-802880A1
	Fill trim pump	
	O-ring at base on new valve	
	Lip of adapter seal	
2-4-C with Teflon	Coupling	92-802859A1
Loctite 271 Threadlocker	Screws	92-809819

Special Tools

Trim Pump Test Gauge Kit		
 73835	Test various trim pumps.	91-52915A6

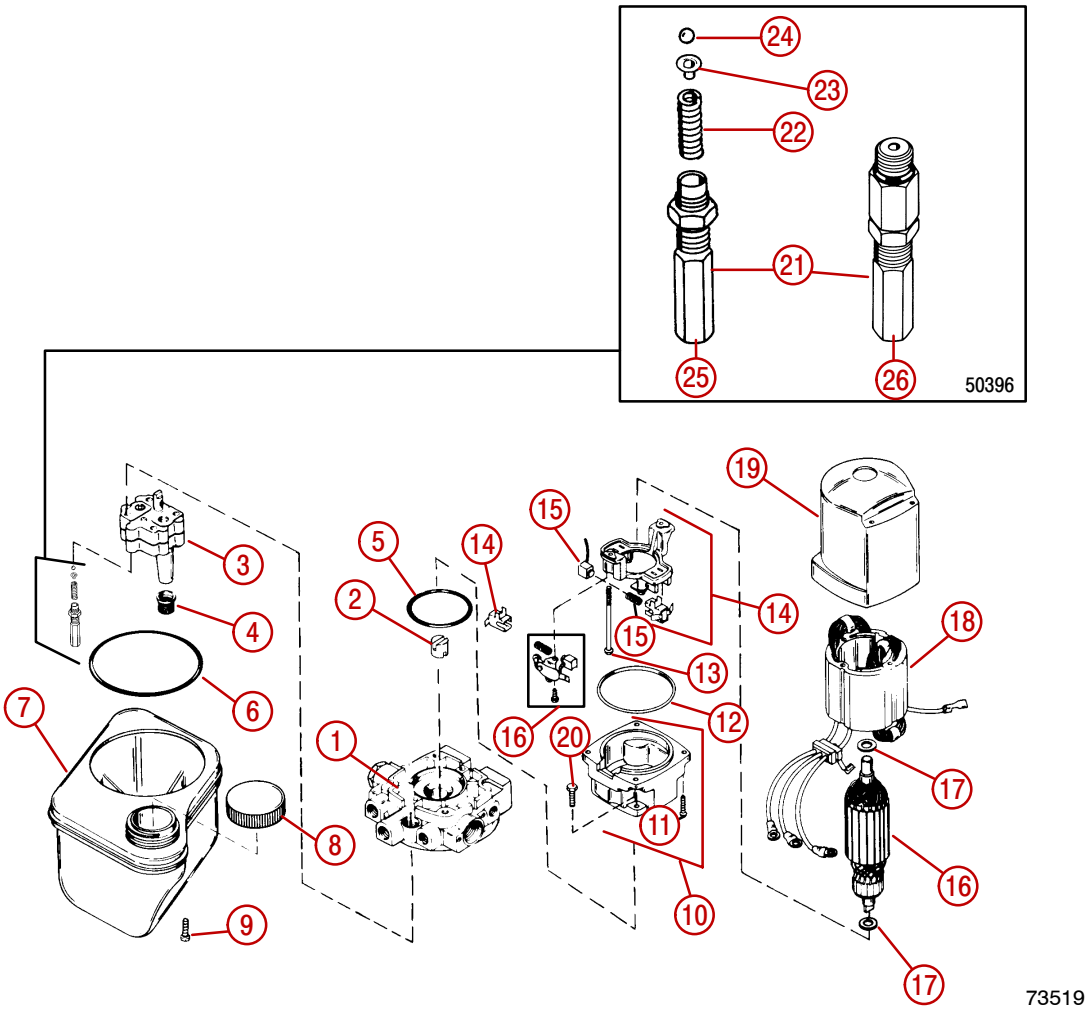
Torque Wrench, lb-in.		
 73430	Sets torques from 9 to 150 lb-in; 3/8 in. drive.	91-66274

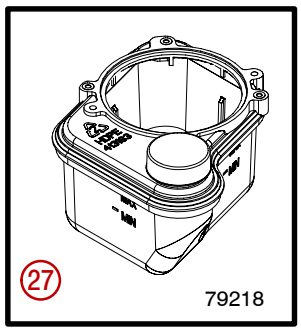
Tools

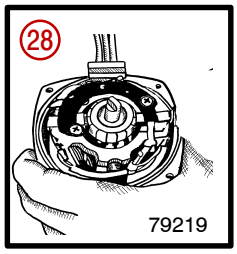
Description	Part Number
Inverted flare plug	22-36809

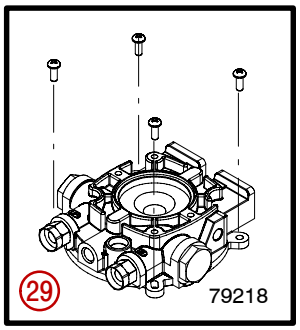
Exploded Views

Trim Pump









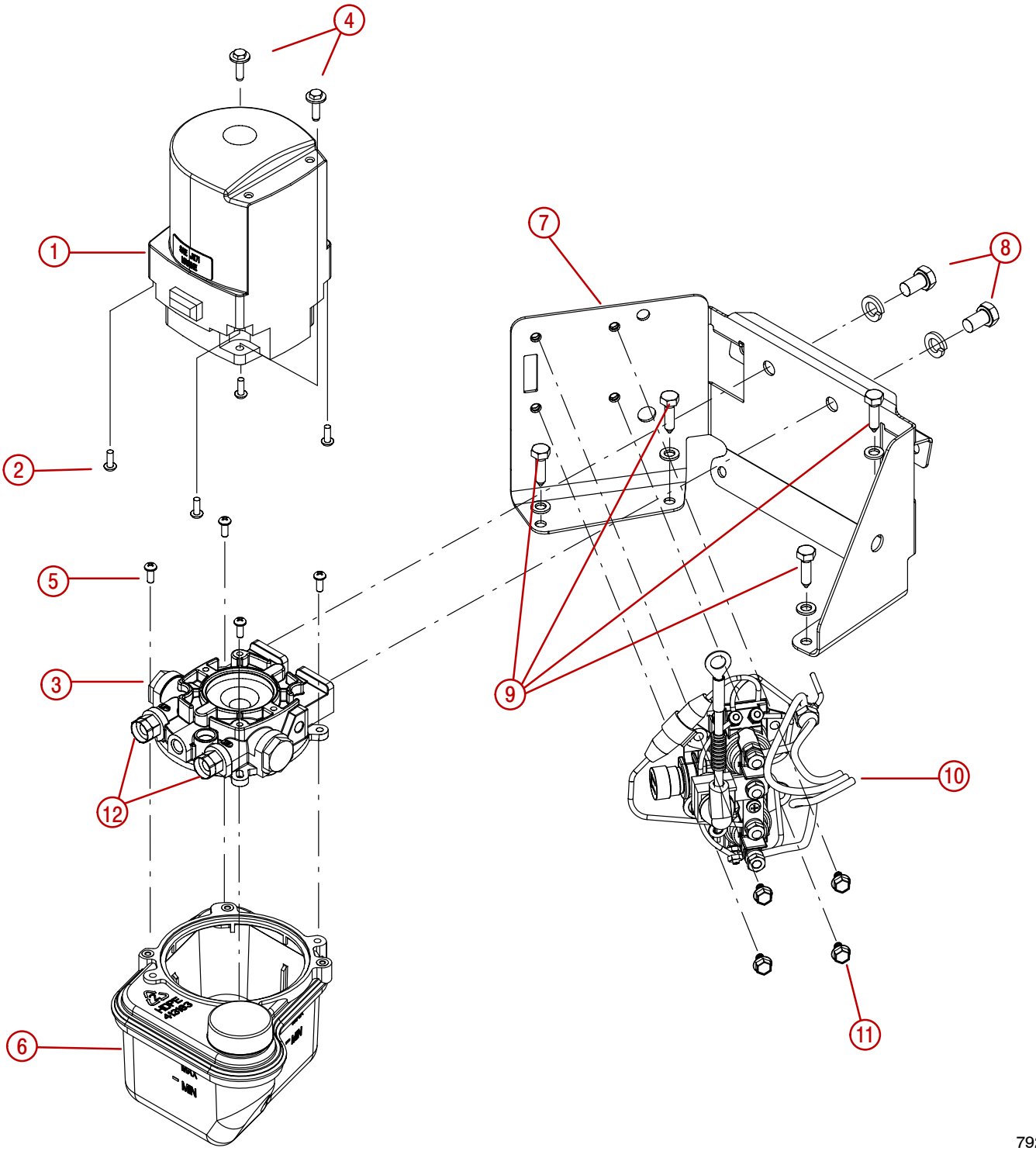
Trim Pump (continued)

1 - Adapter
2 - Coupling
3 - Pump
4 - Filter
5 - O-ring, motor end
6 - O-ring, reservoir end
7 - Reservoir
8 - Cap
9 - Screw (includes O-ring)
10 - End cap with bearing
11 - Screw
12 - O-ring
13 - Screw
14 - Brush holder kit
15 - Brush set
16 - Armature
17 - Thrust washer
18 - Field and frame
19 - Housing
20 - Screw
21 - Relief valve with: ???
22 - Spring
23 - Eyelet
24 - Check ball
25 - Factory installed valve
26 - Replacement valve
27 - Reservoir (later model)
28 - Brush holder kit with circuit board plate and end cap (later model)
29 - Adapter (later model)

NOTE: *The circuit board plate in the brush holder kit was added to the later model trim pump. The hardware and mounting difference are shown.*

Replacement Relief Valve Color Code	
Down pressure	Green
Up pressure	Blue
Thermal	Gold

Later Model Trim Pump And Bracket Hardware



Later Model Trim Pump And Bracket Hardware (continued)

1 - End cap assembly
2 - End cap assembly screw (4)
3 - Adapter assembly
4 - Adapter assembly to end cap assembly screw (2)
5 - Adapter assembly to reservoir assembly screw (4)
6 - Reservoir assembly
7 - Mounting bracket
8 - Adapter assembly to mounting bracket screw and washer (2)
9 - Mounting bracket screw and washer (4)
10 - Motor
11 - Electrical connections to mounting bracket screw and washer (4)
12 - Hydraulic hose adapter fittings

Maintaining Power Trim Pump Oil Level

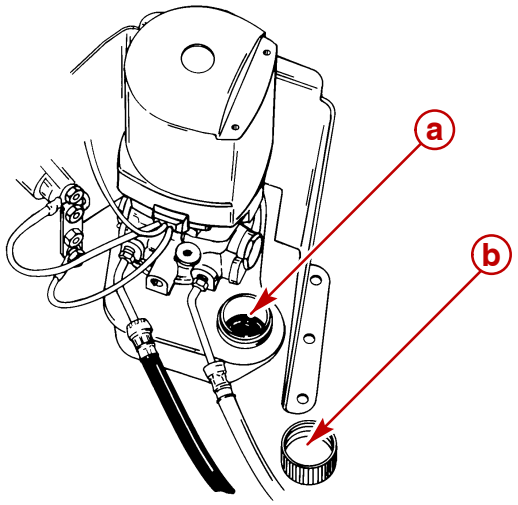
⚠ CAUTION

Avoid pump damage. Vent reservoir pressure by backing out the vent screw two turns after tightening completely. Units without a vent screw have a vented fill cap. Remove the fill neck seal on models without a vent screw.

IMPORTANT: Check the oil level with the sterndrive unit in the full down position.

IMPORTANT: If Power Trim and Steering Fluid is not available, SAE 10W-30 or 10W-40 engine oil can be used in the system.

1. Raise and lower the sterndrive unit 6 to 10 times to purge air from the system. Check the oil level visually.
2. Maintain the oil level between the “Max” and “Min” marks on the side of the reservoir. Fill to the bottom lip on the fill neck.



22031

a - Bottom lip on the fill neck
b - Vented cap

Description	Where Used	Part Number
Power Trim and Steering Fluid	Trim pump	92-802880A1

Air Bleeding Power Trim System

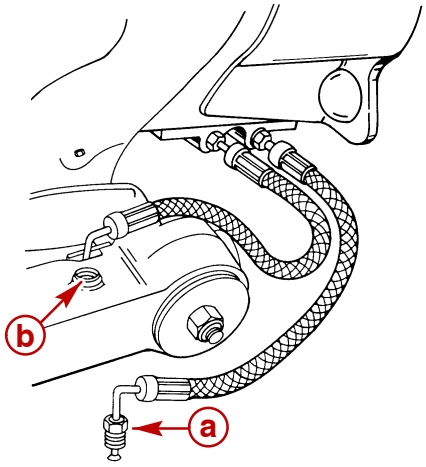
The Power Trim System will purge itself of a small amount of air by raising and lowering the sterndrive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the bleeding procedure should be used to remove the air from the system.

Bleeding OUT/UP Trim Circuit

1. Fill the pump reservoir to the proper level. The trim cylinder must be compressed.
2. Disconnect the OUT/UP hose from the front connection on the trim cylinder. If both cylinders were rebuilt, disconnect the hoses from both cylinders.
3. Direct the end of the removed trim hoses into a container.
4. Operate the trim pump in the OUT/UP direction until a solid, air-free stream of fluid is expelled from the hoses. Reconnect the hoses and torque.

Description	Nm	lb-in.	lb-ft
Trim cylinder hoses	11	100	

5. Unplug shore power (if equipped).
6. Refill the trim pump to the proper level.



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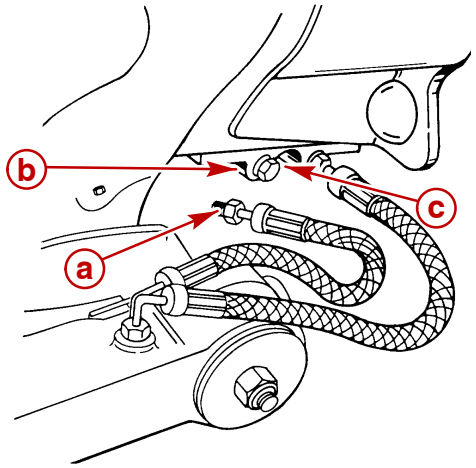
a - OUT/UP trim hose
b - Front connection on trim cylinder

Bleeding IN/DOWN Trim Circuit

1. Ensure that the pump reservoir is filled to the proper level.
2. Disconnect the IN/DOWN hose from the rear connection on the gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect the hoses from both sides of the hydraulic connector.
3. Plug the holes in the hydraulic connector using a inverted flare plug or suitable device.
4. Direct the end of the trim hose into a container.
5. Operate the trim pump in the OUT/UP direction until the trim cylinders are fully extended.
6. Remove the plugs from the gimbal housing hydraulic connector and briefly operate the trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from the rear holes in the hydraulic connector. Reconnect the trim hoses and torque.

Description	Nm	lb-in.	lb-ft
Trim cylinder hoses	11	100	

7. Lower the sterndrive unit to the full IN/DOWN position and refill the trim pump to the proper level. Operate the trim system IN/DOWN and OUT/UP several times and recheck the fluid level.



50389

a - IN/DOWN trim hose
b - Hydraulic connector
c - Inverted flare plug

Description	Part Number
Inverted flare plug	22-36809

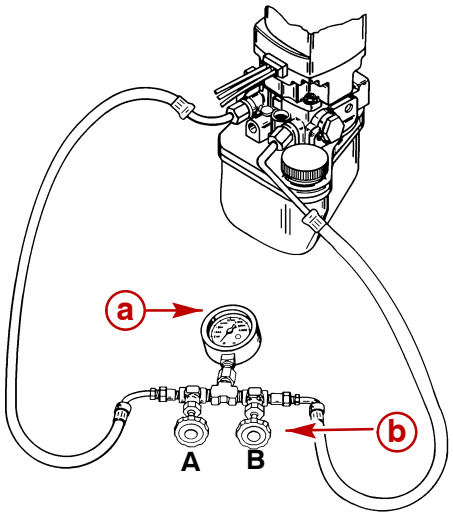
Testing Power Trim Pump

⚠ CAUTION

Cross connecting trim hoses will damage the sterndrive housing. Appropriately mark trim hoses and hose connections to ensure proper reassembly.

Test Gauge

1. Check the trim pump oil level. Fill if necessary.
2. Place the sterndrive unit in the full IN/DOWN position.
3. Connect the test gauge at the most convenient location at pump or hydraulic connector.



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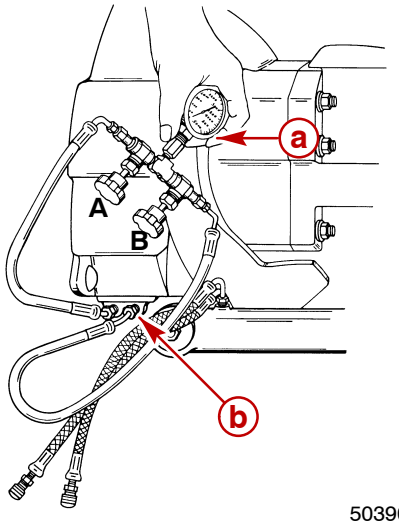
Gauge connected to pump

a - Trim pump test gauge kit
b - Test gauge valves

4. Open valve “A” and “B” and operate the pump OUT/UP and IN/DOWN several times to purge air.



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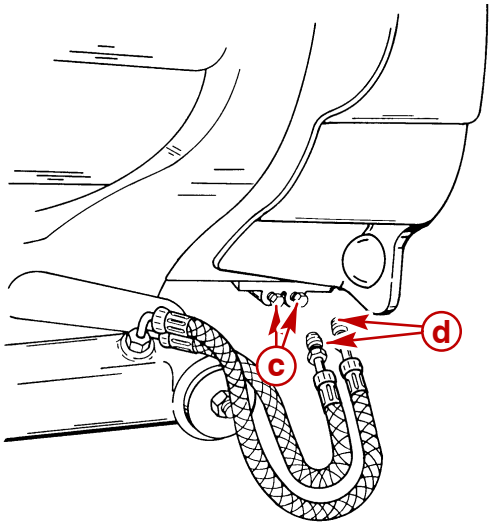
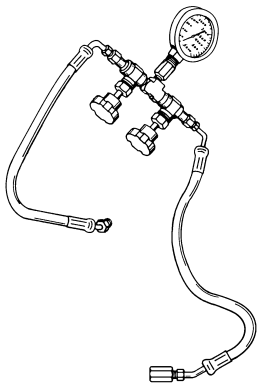


50391

Gauge connected to hydraulic connector

- **a** - Trim Pump Test Gauge Kit
- **b** - Gimbal housing hydraulic connector
- **c** - Caps (supplied with gauge)
- **d** - Plugs (supplied with gauge)

Trim Pump Test Gauge Kit		
 73835	Test various trim pumps.	91-52915A6

Internal Restriction Test

Step	Action	Yes	No
1.	Open valves “A” and “B”. Operate pump OUT/UP and IN/DOWN while observing gauge. **Is gauge reading above 1379kPa (200 psi.)?**	Test Complete	Replace Adapter

OUT/UP Pressure Test

NOTE: *The numbers in quotation marks, e.g. “**3**”, refer to the trim pump hydraulic system diagram on page 5A-12.*

If gauge reading is not within specifications, perform the following:

Step	Action	Yes	No
1.	Leave valve “A” open and close valve “B.” Operate pump OUT/UP while observing the gauge. The reading should be 15173-17932 kPa (2200-2600 psi.) . **Is gauge reading is within specifications?**	Go to Step 3.	Go to step 2.
2.	Replace thermal relief valves “**4**” and retest. **Is gauge reading is within specifications?**	Go to Step 3.	Replace Adapter (2)
3.	Operate the pump OUT/UP until the gauge reading reaches 15173-17932 kPa (2200-2600 psi). Stop pumping OUT/UP. The pressure should not fall below 13104 kPa (1900 psi). **Is gauge reading is 13104 kPa (1900 psi) or above?**	Test Completed	Go to Step 4.
4.	Check for external oil leaks, correct, and retest. **Is gauge reading is 13104 kPa (1900 psi) or above?**	Test Completed	Go To Step 5.
5.	Replace thermal relief valves “**4**” and retest. **Is gauge reading is 13104 kPa (1900 psi) or above?**	Test Completed	Go To Step 6.
6.	Install Trim Pump Rebuild Kit and retest. **Is gauge reading is 13104 kPa (1900 psi) or above?**	Test Completed	Replace Adapter (2)

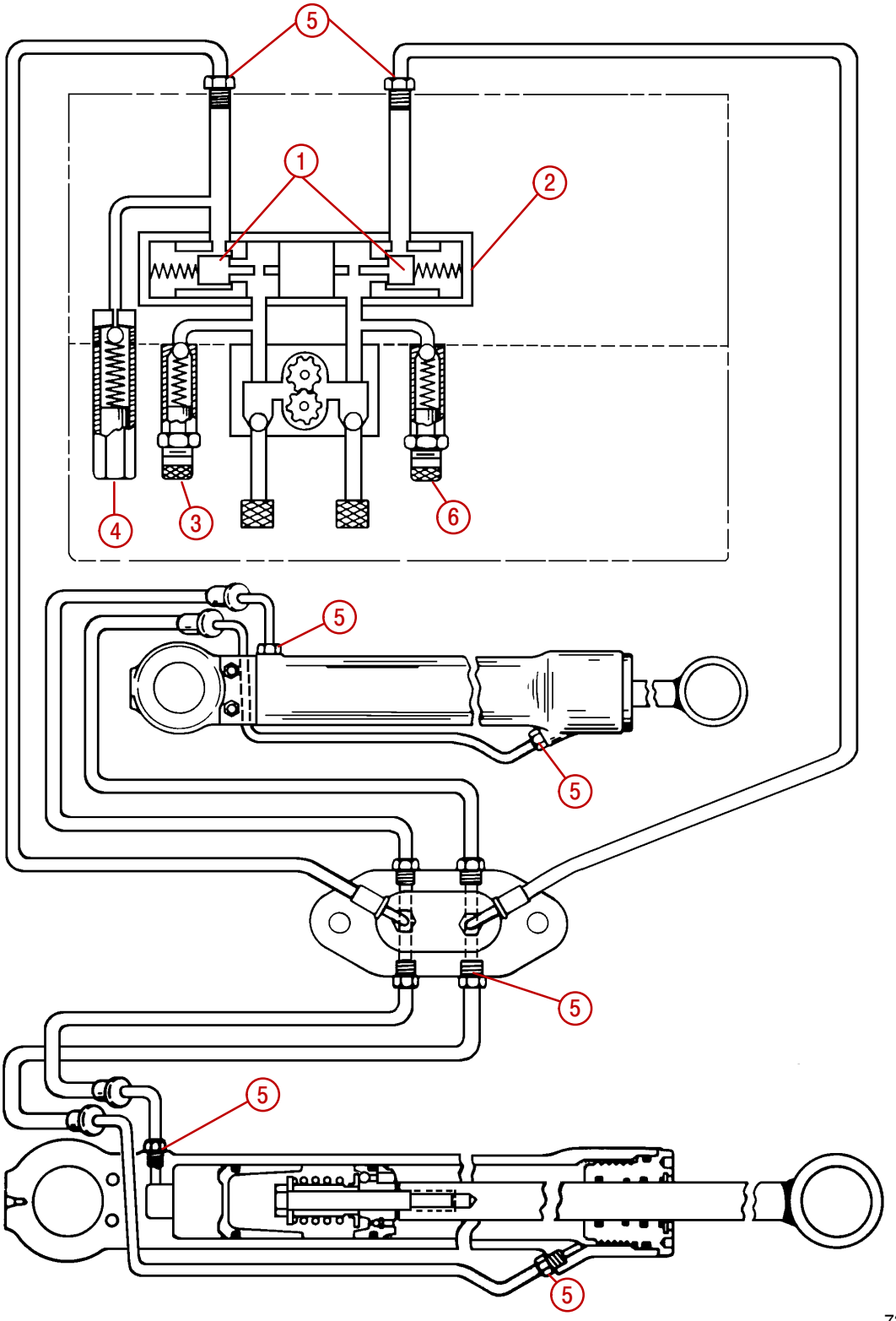
IN/DOWN Pressure Test

NOTE: *The numbers in parentheses, e.g. "**3**", refer to the trim pump hydraulic system diagram on page 5A-12.*

If gauge reading is NOT within specifications, perform the following.

Step	Action	Yes	No
1.	Close valve "A" and open valve "B." Operate the pump IN/DOWN while observing the gauge. The reading should be 2759-4138 kPa (400-600 psi). **Is gauge reading within specifications?**	Go To Step 4.	Go to Step 2.
2.	Replace DOWN pressure release valves "**6**" and retest. **Is gauge reading within specifications?**	Go to Step 4.	Go to Step 3.
3.	Install Trim Pump Rebuild Kit. **Is gauge reading within specifications?**	Go To Step 4.	Replace Adapter (2)
4.	Operate pump IN/DOWN until gauge reading reaches 2759-4138 kPa (400-600 psi). Stop pumping IN/DOWN. Pressure should not fall below 2414 kPa (350 psi). **Is gauge reading above 2414 kPa (350 psi)?**	Test Completed	Go To Step 5.
5.	Check for external oil leaks correct and retest. **Is gauge reading above 2414 kPa (350 psi)?**	Test Completed	Go To Step 6.
6.	Install Trim Pump Rebuild Kit and retest. **Is gauge reading above 2414 kPa (350 psi)?**	Test Completed	Replace Adapter

Trim Pump Hydraulic System



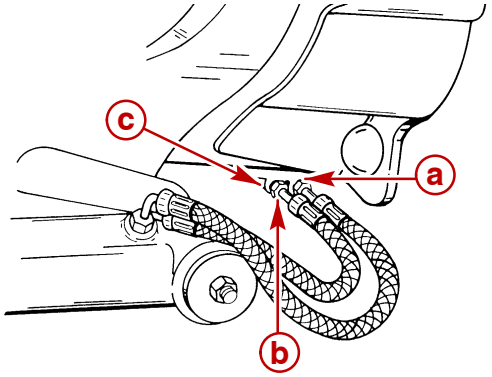
73552

1 - Poppet valves
2 - Pump adapter
3 - OUT/UP pressure relief valve
4 - Thermal relief valve
5 - Fitting
6 - IN/DOWN pressure relief valve

Trim Cylinder Internal Leak Test

IMPORTANT: Before performing the following test, ensure that OUT/UP pressure meets specifications designated in OUT/UP pressure test.

1. Reconnect the trim cylinder hoses if disconnected.
   a. Remove the plugs and caps.
   b. Install the OUT/UP hose to the forward hole on the hydraulic connector and torque.
   c. Install the IN/DOWN hose to the aft hole on the hydraulic connector and torque.

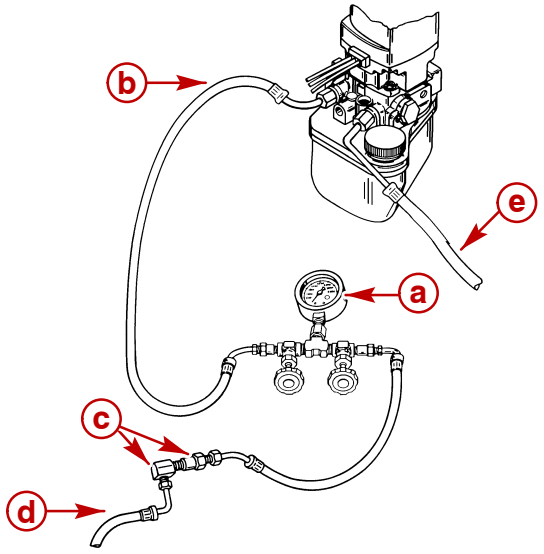


50391

a - OUT/UP hose
b - IN/DOWN hose
c - Hydraulic connector

Description	Nm	lb-in.	lb-ft
Trim cylinder hoses	11	100	

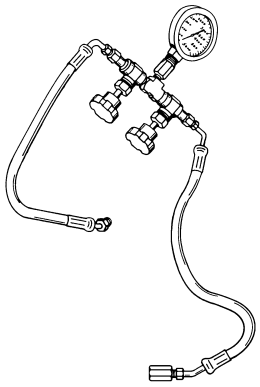
2. Connect the gauge at the most convenient location.



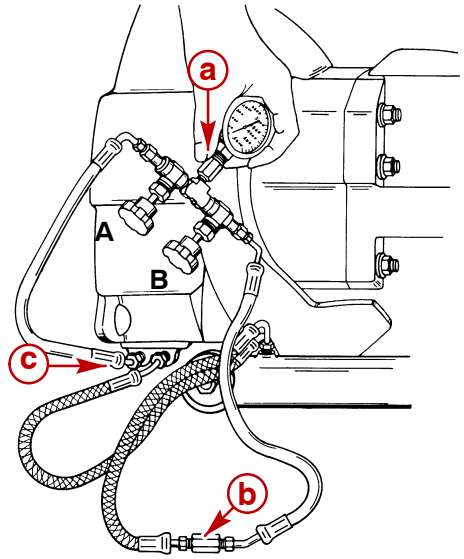
70598

Gauge connected to pump

- **a** - Hydraulic test gauge
- **b** - Hose connected to UP (left hole)
- **c** - Fittings - (supplied with gauge)
- **d** - BLACK hose (from gimbal housing)
- **e** - GREY Hose (from gimbal housing)

Trim Pump Test Gauge Kit		
 73835	Test various trim pumps.	91-52915A6

NOTE: *If the gauge is connected at the pump, reconnect the gauge at the gimbal housing hydraulic connector. Repeat step 3, then operate the pump in the OUT/UP direction until the trim cylinder is fully extended.*



50390

Gauge connected to hydraulic connector

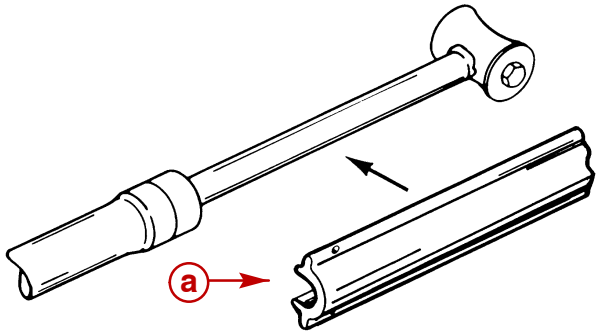
a - Test gauge
b - Coupling (supplied with gauge)
c - Front hydraulic connector port

Step	Action	Yes	No
1.	Open valves “A” and “B” and operate the pump OUT/UP and IN/DOWN several times to purge air. Operate the pump OUT/UP until the trim cylinders are fully extended. Observe the gauge while pumping. The pressure should be 15173-17932 kPa (2200-2600 psi).Stop pumping OUT/UP. Pressure should not fall below 13104 kPa (1900 psi). **Is the reading below 13104 kPa (1900 psi)?**	This indicates a trim cylinder leak Go To Step 2	Test Complete
2.	Close one valve on the test gauge and repeat Steps 1. **Is the reading above 13104 kPa (1900 psi)?**	Replace cylinder on same side of test gauge connection.	Replace cylinder on opposite side of test gauge connection.

Trim Cylinder Shock Piston Test

If all previous trim system test results meet specifications, but sterndrive unit will not trim IN/DOWN, the problem may be a leaky trim cylinder shock piston. Use the following test to check for this condition. No test gauge is required.

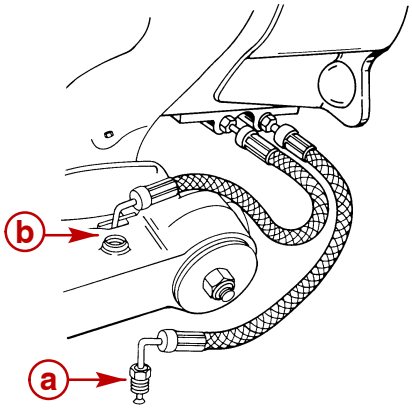
1. Operate the pump in the OUT/UP direction until the trim cylinders are fully extended.
2. Use a suitable devise to keep trim cylinder piston rods from retracting, such as trailering clips.



22562

a - Trailering clip

3. Disconnect the UP trim hose from trim cylinders.



50389

a - UP trim hose
b - Front connection

4. Operate the pump in the IN/DOWN direction. If oil flows from the UP port on the trim cylinder, the shock piston is leaking and must be replaced.

Motor and Electrical Bench Tests

Trim Pump Motor Test (In Boat)

⚠ WARNING

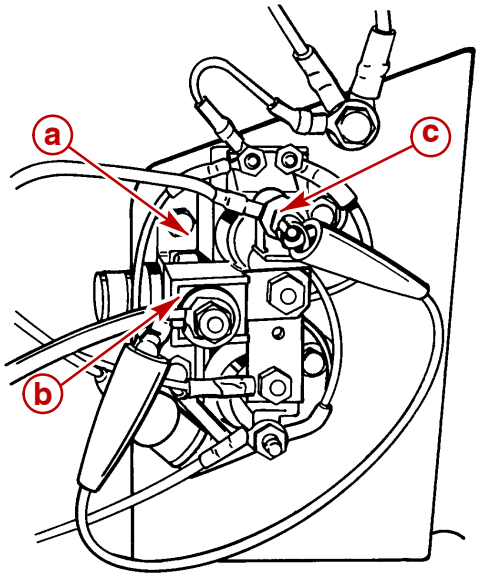
Making electrical connections may cause a spark. Do not perform this test near flammables or explosives.

⚠ WARNING

Remain clear of the sterndrive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

OUT/UP OPERATION

1. Connect a jumper wire between the positive (+) solenoid terminal and the BLUE/WHITE motor lead terminal.



22494

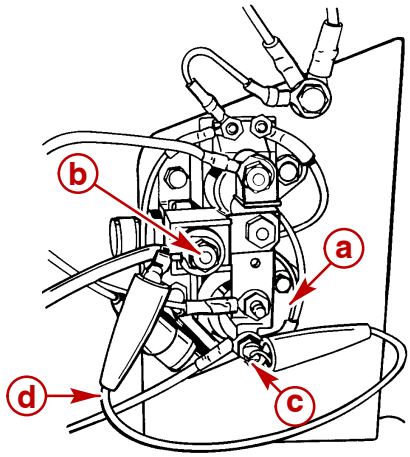
IN / DOWN position

a - OUT/UP solenoid
b - Positive terminal (+)
c - Negative supply lead

2. If the motor does not operate, refer to **Motor Repair**.

IN/DOWN OPERATION

1. Connect a jumper wire between the positive (+) solenoid terminal and the GREEN/WHITE motor lead terminal.



73556

a - IN/DOWN solenoid
b - Positive terminal (+)
c - GREEN/WHITE motor lead terminal
d - Jumper wire

2. If the motor does not operate, refer to **Motor Repair**.

Trim Pump Motor Test (Out of Boat)

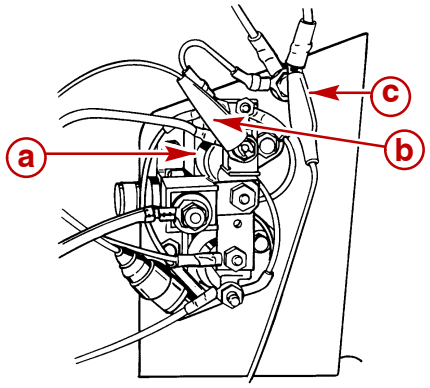
⚠ WARNING

Making electrical connections may cause a spark. Do not perform this test near flammables or explosives.

1. Remove the trim pump from the boat. Refer to **Trim Pump Removal**.
2. Remove the fluid from the trim pump reservoir.

OUT/UP OPERATION

1. Connect a 12 volt positive (+) supply lead to the BLUE/WHITE motor lead terminal.
2. Connect the negative (–) supply lead to a good ground on the pump.



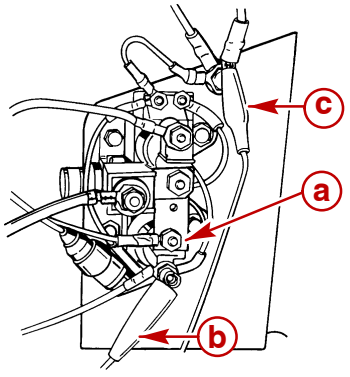
22495

a - OUT/UP solenoid
b - 12 Volt positive (+) supply lead
c - Negative supply lead

3. If the motor does not operate, refer to **Motor Repair**.

IN/DOWN OPERATION

1. Connect a 12 volt positive (+) supply lead to the GREEN/WHITE motor lead terminal.
2. Connect the negative (–) supply lead to a good ground on the pump.



22494

a - IN/DOWN solenoid
b - 12 volt positive supply (+) lead
c - GREEN/WHITE motor lead
d - Jumper wire

3. If the motor does not operate, refer to **Motor Repair**.

Solenoid Test (Pump In Boat)

⚠ WARNING

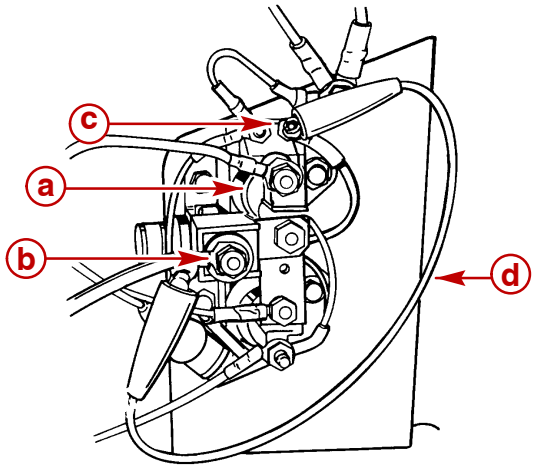
Do not perform this test near flammables or explosives as a spark may occur when making connections.

⚠ CAUTION

Remain clear of the sterndrive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

UP/OUT SOLENOID

1. Connect a jumper wire between the positive (+) solenoid terminal and the BLUE/WHITE harness wire terminal.



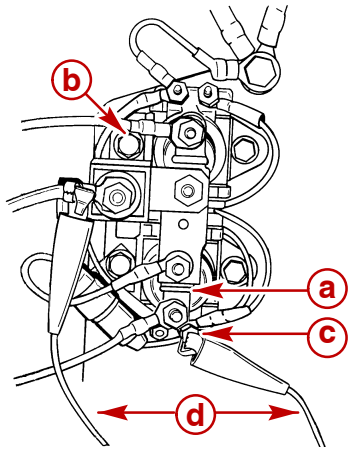
22495

a - OUT/UP solenoid
b - Positive (+) solenoid terminal
c - BLUE/WHITE harness wire terminal
d - Jumper wire

2. If the motor does not operate, refer to **Motor Repair**.

IN/DOWN SOLENOID

1. Connect a jumper between the positive (+) solenoid terminal and the GREEN/WHITE harness wire terminal.



22494

a - IN/DOWN solenoid
b - Positive (+) solenoid terminal
c - GREEN/WHITE harness wire terminal
d - Jumper wire

2. If the pump motor does not operate in one direction or another, replace the appropriate solenoid.

NOTE: *Refer to the wiring diagram at the end of this section.*

Solenoid Test (Pump Out of Boat)

⚠ WARNING

Do not perform this test near flammables or explosives as a spark may occur when making connections.

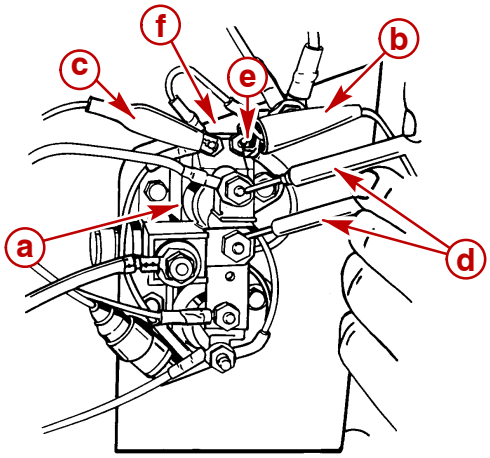
1. Remove the trim pump from the boat. Refer to **Trim Pump Removal**.
2. Remove the fluid from the trim pump reservoir.

⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

OUT/UP SOLENOID

1. Connect a 12 volt positive (+) supply lead to BLUE/WHITE harness terminal wire.
2. Connect the negative (–) supply lead to the solenoid ground terminal.
3. Connect the ohmmeter leads to the large terminals on the solenoid.



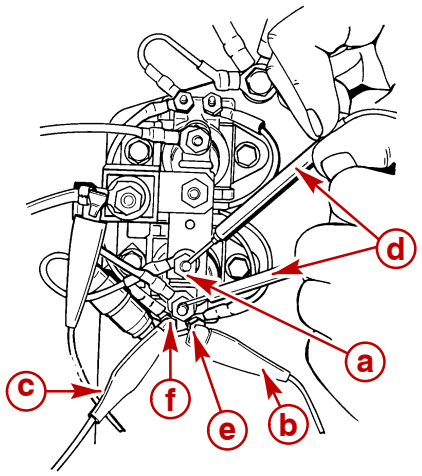
22493

a - OUT/UP solenoid
b - 12 volt positive (+) supply lead
c - Negative (–) supply lead
d - Ohmmeter leads
e - BLUE/WHITE harness wire terminal
f - Solenoid ground terminal

4. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.
   High Ohms Reading (No Continuity)-Replace solenoid.

IN/DOWN SOLENOID

1. Connect a 12 volt positive (+) supply lead to the GREEN/WHITE harness wire terminal.
2. Connect the negative (–) supply lead to the solenoid ground terminal.
3. Connect the ohmmeter leads to the large terminals on the solenoid.



22494

a - IN/DOWN solenoid
b - 12 Volt positive (+) supply lead
c - Negative (–) supply lead
d - Ohmmeter leads
e - GREEN/WHITE harness wire terminal
f - Solenoid ground terminal

4. **Zero Ohms Reading** (Full continuity)-Solenoid is OK.
   High Ohms Reading (No continuity)-Replace solenoid.

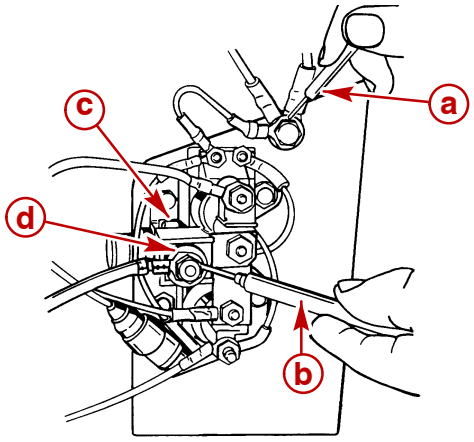
NOTE: *Refer to the wiring diagram at the end of this section.*

110 Amp Fuse Test (Pump in Boat)

⚠ WARNING

Do not perform this test near flammables (or explosives) as a spark may occur when making connections.

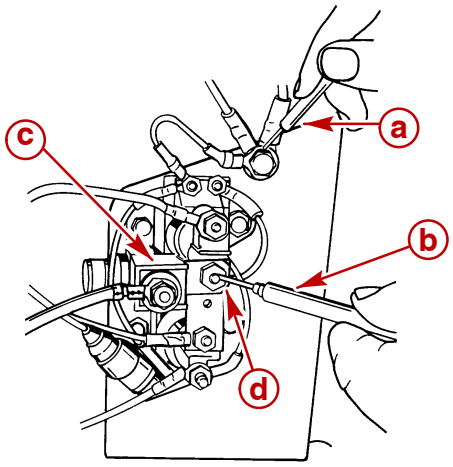
1. Check for voltage at battery power terminal using a volt meter. Voltage must be indicated before proceeding with the next check.



22495

a - Volt meter negative (–) lead
b - Volt meter positive (+) lead
c - Fuse (RED in color)
d - Battery power terminal

2. Check for voltage at protected terminal of 110 amp fuse using a volt meter.



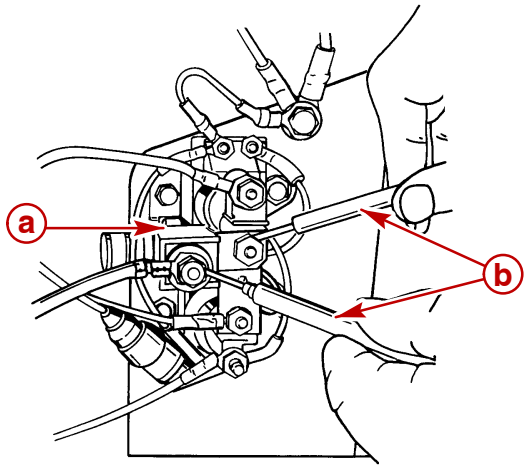
22493

a - Volt meter negative (–) lead
b - Volt meter positive (+) lead
c - Fuse (red in color)
d - Protected terminal of 110 amp fuse

3. **Voltage Indicated:** Fuse OK.
Voltage Not Indicated: Replace the fuse.

110 Amp Fuse Test (Pump Out of Boat)

1. Connect the ohmmeter leads between the terminals on the fuse.



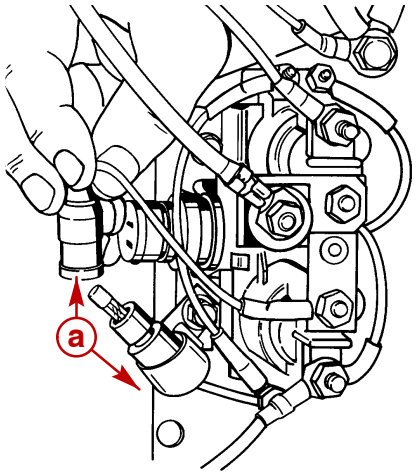
22493

a - 110 amp fuse (red)
b - Ohmmeter leads

2. **Zero Ohms Reading** (Full Continuity)-Fuse OK.
   High Ohms Reading (No Continuity)-Replace fuse.

20 Amp Fuse Test

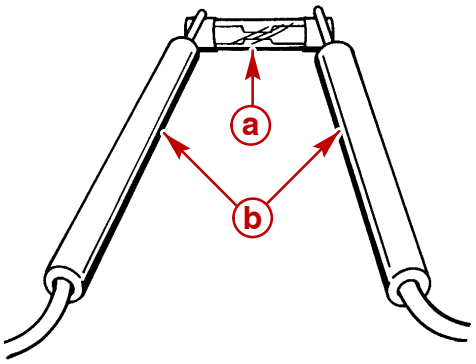
1. Remove the fuse from the fuse holder.



22496

a - Fuse holder

2. Connect one ohmmeter lead to each end of the fuse.



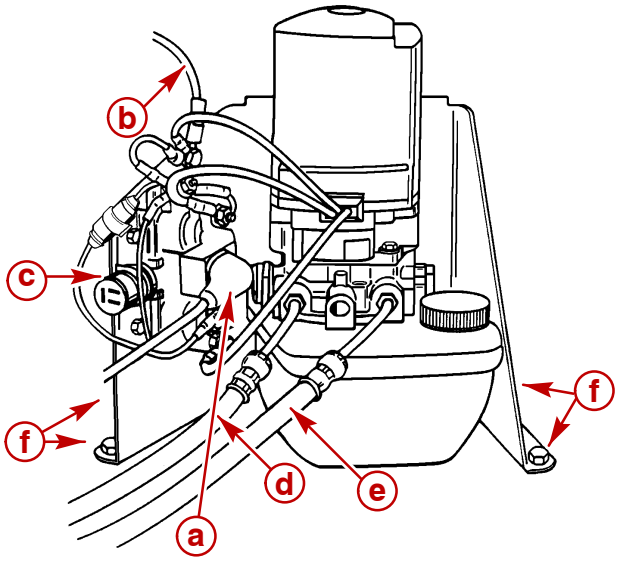
22497

a - 20 Amp fuse
b - Ohmmeter leads

3. **Zero Ohms Reading** (Full continuity)-Fuse OK.
High Ohms Reading (No continuity)-Replace fuse.

Trim Pump Removal

1. Disconnect the trim pump battery leads from the power source. Disconnect the negative lead first.
2. Disconnect the trim harness connector (3 pronged connector) from the trim pump.
3. Remove the hydraulic hoses from the trim pump. Cap the hose ends.
4. Remove the lag bolts and washers and lift the pump and floor bracket from the boat.



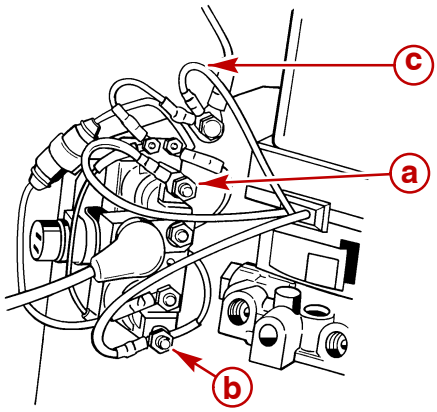
22459

a - Positive battery lead
b - Negative battery lead
c - Harness connector
d - BLACK hydraulic hose (UP hose)
e - GRAY hydraulic hose (DOWN hose)
f - Lag bolts and washers

Hydraulic Repair

Disassembly

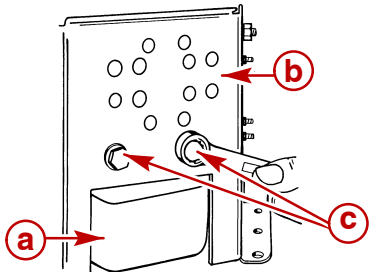
1. Disconnect the trim motor wires.



70359

a - BLUE/WHITE motor wire
b - GREEN/WHITE motor wire
c - BLACK ground wire

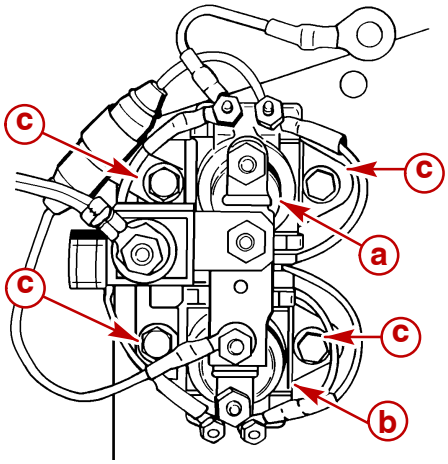
2. Remove the mounting bolts and trim pump from the floor bracket.



22548

a - Trim pump
b - Floor bracket
c - Mounting bolts

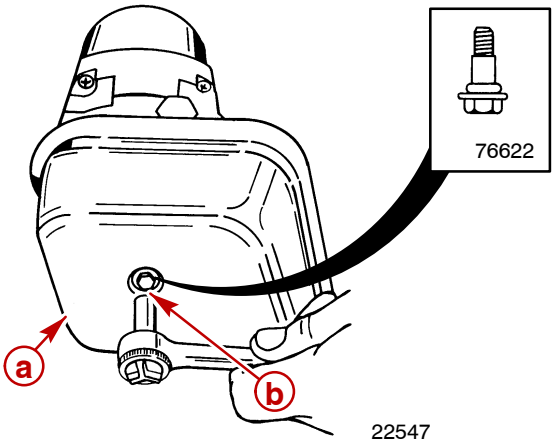
3. Remove the solenoids if replacement is necessary.



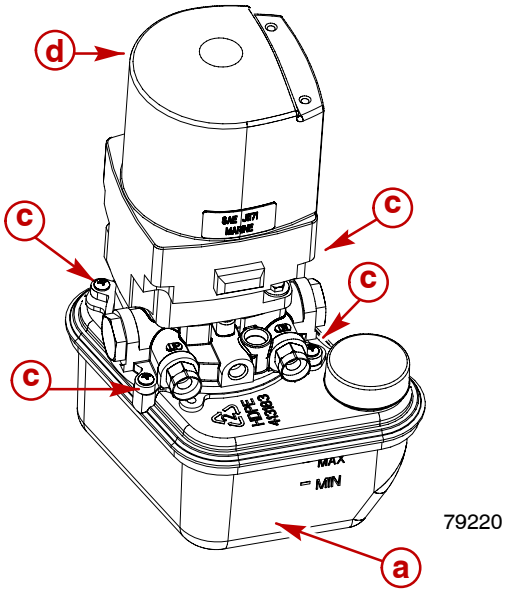
70232

a - UP solenoid
b - DOWN solenoid
c - Mounting bolts (2 on each solenoid)

4. Remove the pump reservoir.



Early model reservoir bottom mount

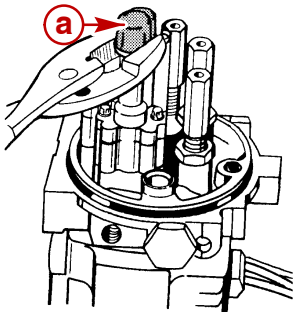


Later model reservoir top mount

a - Pump reservoir
b - Bolt and O-ring (early model)
c - Top mount (4) screws (later model)
d - Pump motor

Filter Replacement

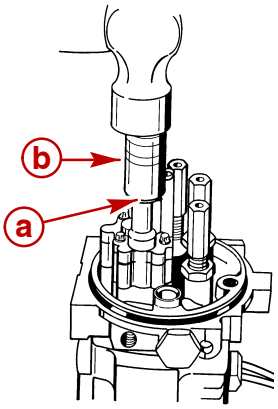
1. Remove the filters by twisting while pulling upward.



76887

a - Filters (2)

2. Install new filters.



76888

a - Filters (2)
b - 5/8 in. socket

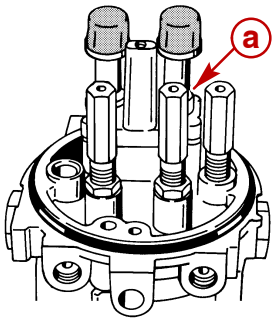
UP Pressure Relief Valve Replacement

NOTE: *The UP pressure relief valve in the kit is BLUE for easy identification.*

IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, do not loosen or attempt to remove the hex jam nut. This valve is preset at the factory for proper UP pressure relief.

IMPORTANT: The thermal relief valve is factory preset. Do not loosen or attempt to separate the component parts. Do not use a wrench on the upper gold colored fitting. Use a wrench on the lower hex-fitting to tighten the relief valve.



70872

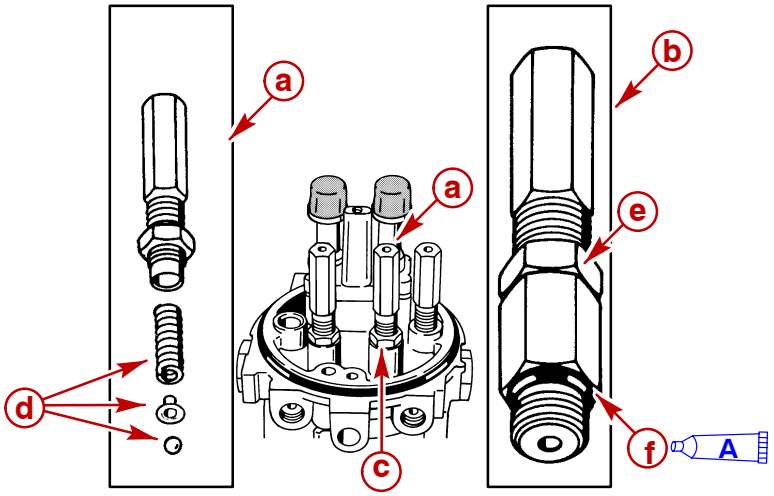
a - Factory installed UP pressure relief valve

Description	Where Used	Part Number
Power Trim and Steering Fluid	O-ring at base on new valve	92-802880A1

NOTE: *Factory installed pressure relief valves will be a natural steel finish - they will not be color coded.*

1. Loosen jam nut on UP pressure relief valve and remove valve.
2. Remove the pump body components and discard.
3. Ensure that the threaded hole is free of dirt.

4. Lubricate the O-ring at the base of the new valve and install valve.
5. Tighten at the base of the new valve and torque.



50396 70872 50396

a - Factory installed UP pressure relief valve
b - Replacement UP pressure relief valve
c - Jam nut
d - Pump body components (spring, eyelet, and check ball)
e - Jam nut
f - O-ring

Description	Nm	lb-in.	lb-ft
UP pressure relief valve	7.9	70	

Description		Where Used	Part Number
A	Power Trim and Steering Fluid	O-ring at base on new valve	92-802880A1

DOWN Pressure Relief Valve Replacement

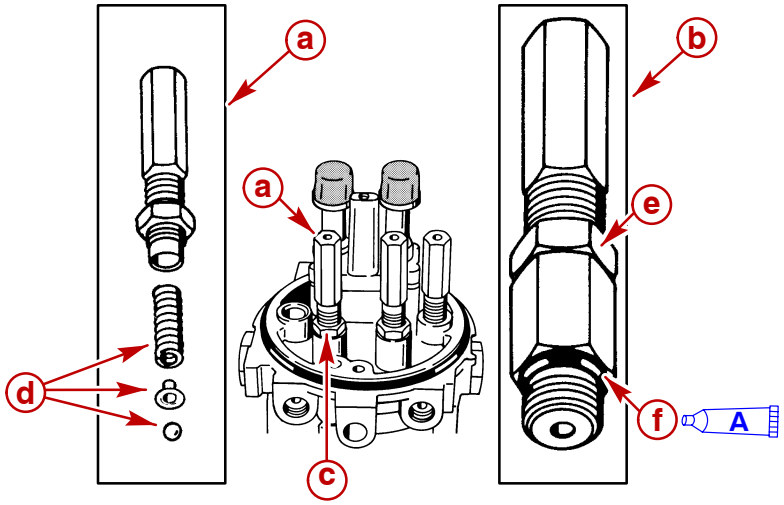
NOTE: *The DOWN pressure relief valve in the kit is GREEN for easy identification.*

IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, do not loosen or attempt to remove the hex jam nut. This valve is preset at the factory for proper DOWN pressure relief.

IMPORTANT: The thermal relief valve is factory preset. Do not loosen or attempt to separate the component parts. Do not use a wrench on the upper gold colored fitting. Use a wrench on the lower hex-fitting to tighten the relief valve.

1. Loosen jam nut on DOWN pressure relief valve and remove valve.
2. Remove the pump body components and discard.
3. Ensure that the threaded hole is free of dirt.
4. Lubricate the O-ring at the base of the new valve and install valve.
5. Tighten at the base of the new valve and torque.



50396 70872 50396

a - Factory installed DOWN pressure relief valve
b - Replacement DOWN pressure relief valve (green)
c - Jam nut
d - Pump body components (spring, eyelet, and check ball)
e - Jam nut
f - O-ring

Description		Where Used	Part Number
A	Power Trim and Steering Fluid	O-ring at base on new valve	92-802880A1

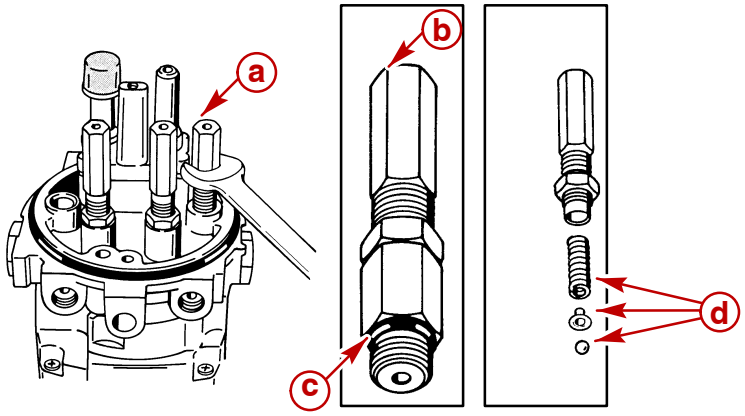
Description	Nm	lb-in.	lb-ft
DOWN pressure relief valve	7.9	70	

Thermal Relief Valve Replacement

NOTE: *The Thermal Relief Valve in the kit is GOLD for easy identification.*

IMPORTANT: The thermal relief valve is factory preset. Do not loosen or attempt to separate the component parts. Do not use a wrench on the upper gold colored fitting. Use a wrench on the lower hex-fitting to tighten the relief valve.

1. Remove the thermal relief valve.
2. Remove the pump body components and discard.
3. Ensure that the threaded hole is free of dirt.
4. Lubricate the O-ring at the base of the new valve and install valve.
5. Tighten using the base of the new valve and torque.



70836

a - Original thermal relief valve
b - Replacement thermal relief valve (gold)
c - O-ring
d - Pump body components (spring, eyelet, check ball)

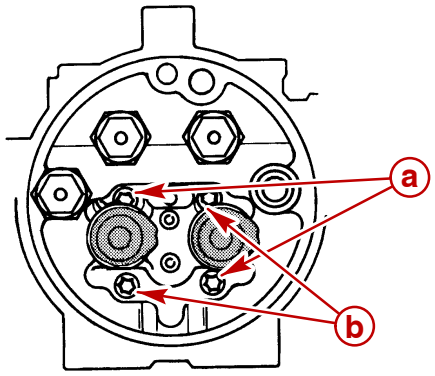
Description	Where Used	Part Number
Power Trim and Steering Fluid	O-ring at base on new valve	92-802880A1

Description	Nm	lb-in.	lb-ft
Thermal relief valve	7.9	70	

Pump Replacement

NOTE: *The pump cannot be re-built. If the pump is defective, replace it as an assembly.*

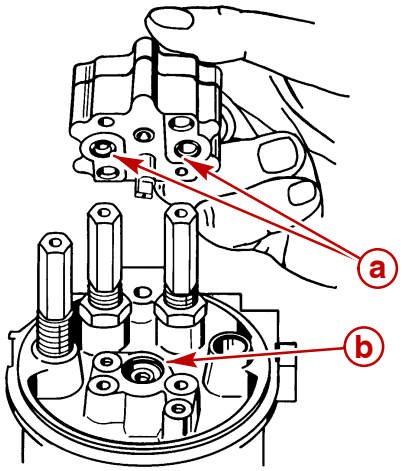
1. Remove the pump attaching screws with a hex lobular socket or standard 5 mm (3/16 in.) socket and the pump. Do not loosen the pump attaching screws.



70870

a - Screw
b - Pump attaching screws

2. Remove the O-rings from the old pump and install them on the new pump.
3. Lubricate the lip of the adapter seal.

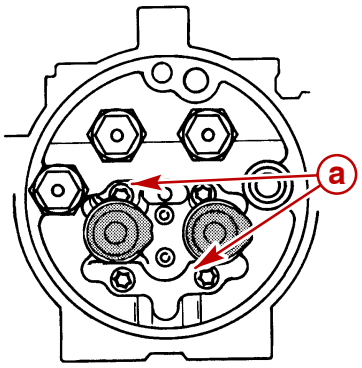


22545

a - O-rings
b - Adapter seal

Description	Where Used	Part Number
Power Trim and Steering Fluid	Lip of adapter seal	92-802880A1

4. Install the pump and torque the pump attaching screws using a hex lobular socket or standard 1/4 in. twelve point socket.



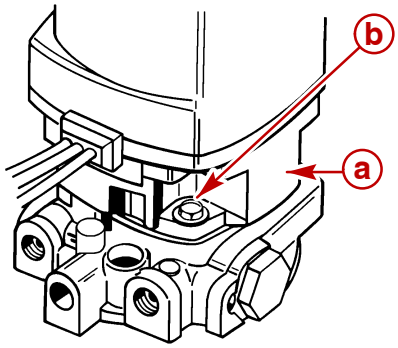
70870

a - Pump attaching screws

Description	Nm	lb-in.	lb-ft
Pump attaching screws	7.9	70	

Adapter Replacement

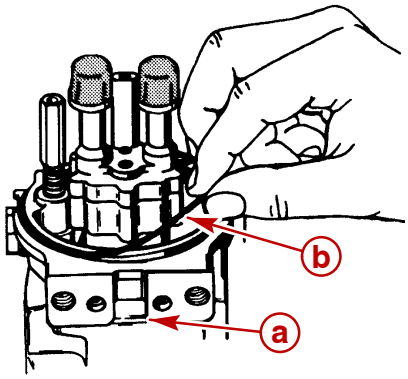
1. Remove the pump motor attaching screws and remove the pump motor.



70599

a - Pump motor
b - Screws (2)

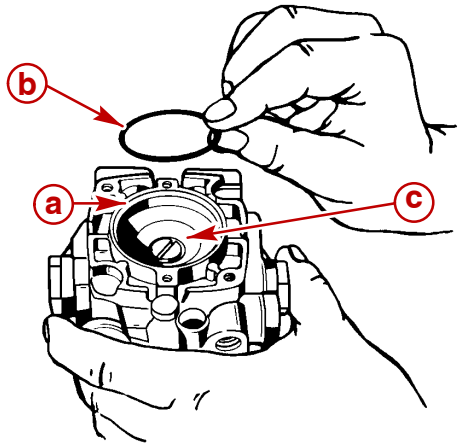
2. Remove and discard the adapter to reservoir O-ring.



70869

a - Adapter
b - O-ring

3. Remove and discard the motor to adapter O-ring.
4. Ensure that the coupling is installed with the shallow slot toward the reservoir.
5. Lubricate the coupling.

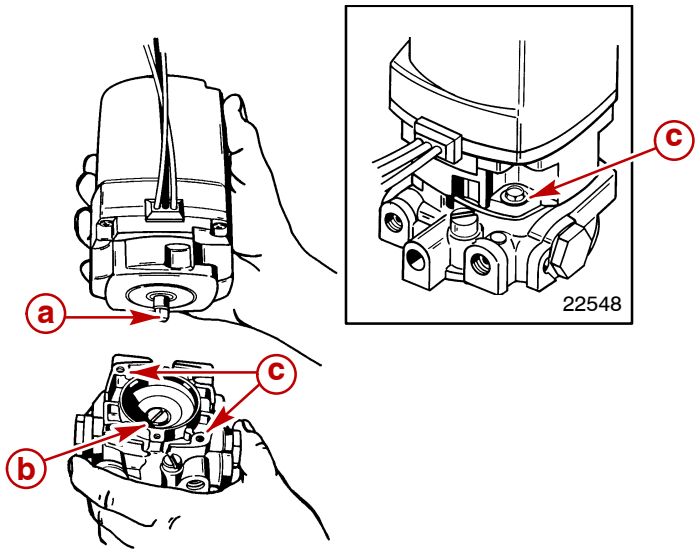


70600

a - Adapter
b - O-ring
c - Coupling - (shallow slot toward reservoir)

Description	Where Used	Part Number
2-4-C with Teflon	Coupling	92-802859A1

6. Install a new motor to adapter O-ring.
7. Align the motor shaft with the coupling and install the motor onto the adapter.
8. Position the motor as shown and secure with screws. Tighten securely.



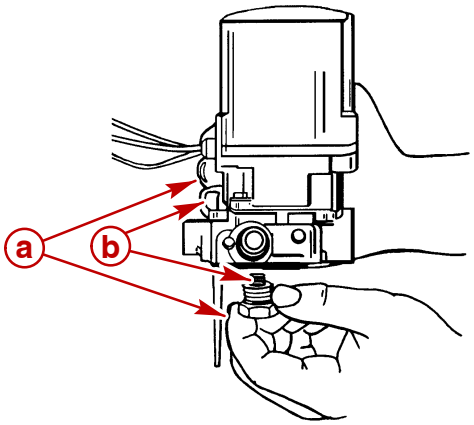
22496

a - Motor shaft
b - Coupling
c - Screws (opposite corners)

Adapter Repair

INTERNAL O-RING AND POPPET VALVE REPLACEMENT

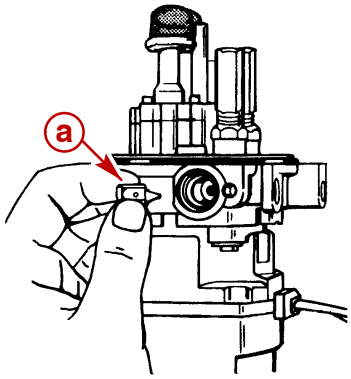
1. Remove the hex plug retainers and springs (one on each side).



70871

a - Hex plug retainers (2)
b - Springs (2)

2. Remove and discard the poppet valves.



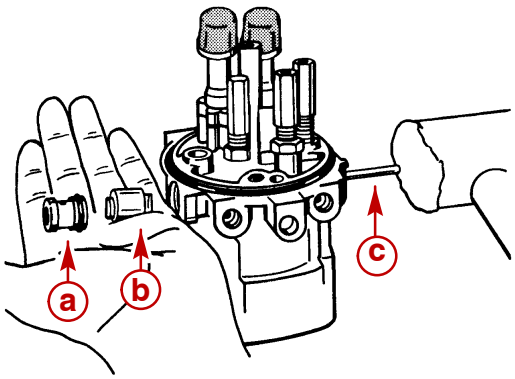
76889

a - Poppet valve

⚠ CAUTION

Use care in removing check valve bodies from adapter, so as not to damage poppet valve seat surface on valve body.

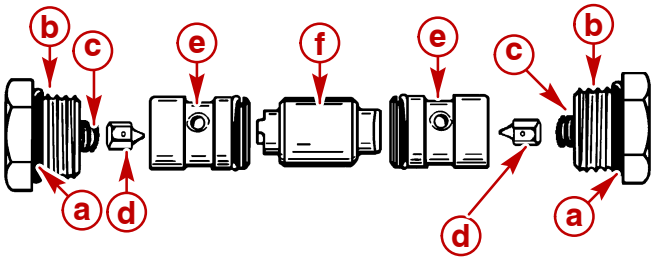
3. Remove the check valve bodies and spool using a 3 mm (1/8 in.) diameter metal rod and plastic hammer.



76890

a - Check valve body
b - Spool
c - Metal rod 3 mm (1/8 in.) diameter

4. Remove and discard the O-rings on the hex plug retainers.
5. Discard the check valve bodies.
6. Clean the hex plug retainers and spool.



70867

a - O-rings
b - Hex plug retainers
c - Springs
d - Poppet valves
e - Check valve bodies
f - Spool

7. Lubricate the check valve body O-rings.

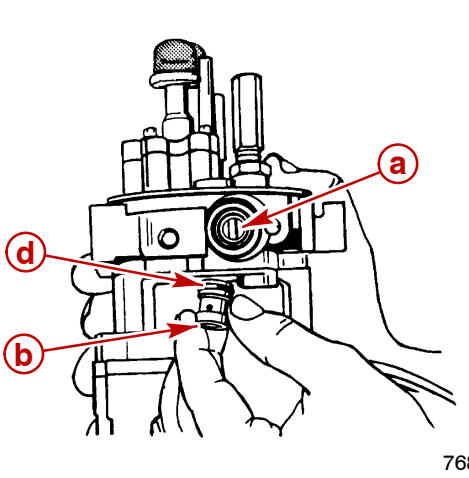
Description	Where Used	Part Number
Power Trim and Steering Fluid	Check valve body O-rings	92-802880A1

⚠ CAUTION

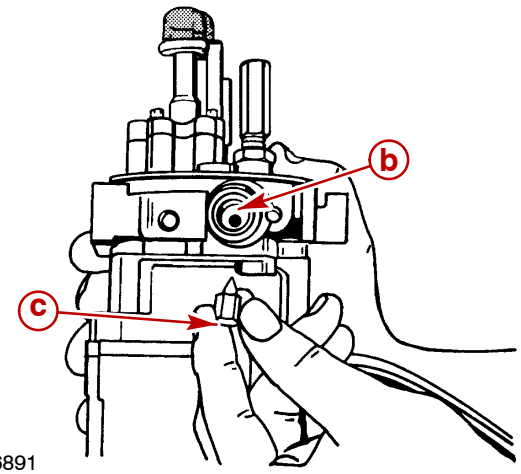
Do not force check valve bodies into adapter as damage to O-rings may result.

8. Place the spool and check valve bodies into the adapter.

9. Place the poppet valves into the check valve bodies.



76891



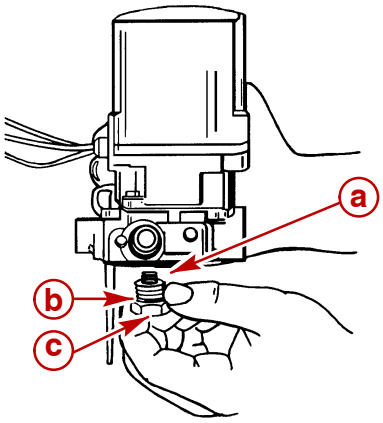
76892

a - Spool
b - Check valve body (2)
c - Poppet valve (2)
d - Check valve body O-ring

10. Lubricate the hex plug retainer O-rings.

Description	Where Used	Part Number
Power Trim and Steering Fluid	Hex plug retainer O-rings	92-802880A1

11. Place the springs into the hex plug retainers.
12. Thread the hex plug retainers into the adapter by hand until the retainer contacts the check valve body.



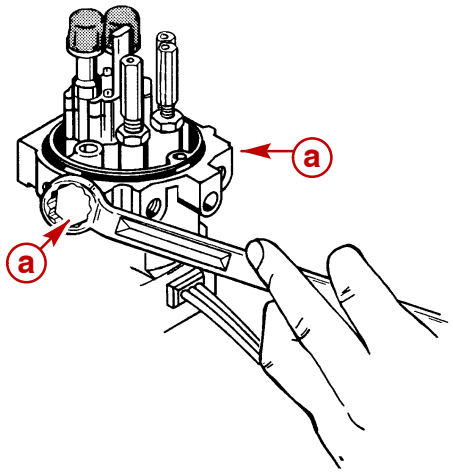
70871

a - Spring (2)
b - O-ring
c - Hex plug retainer (2)

⚠ CAUTION

Hex plug retainers must be turned into adapter exactly as outlined or damage to check valve body O-rings may result.

13. Tighten the hex plug retainer securely on each side.

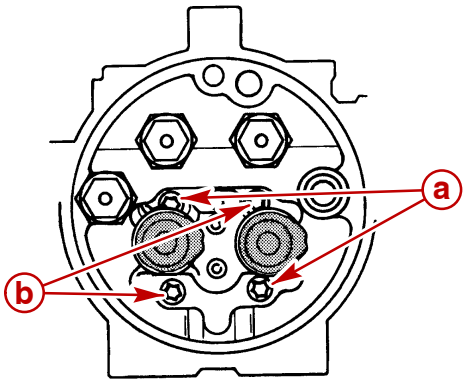


76893

a - Hex plug retainer

Pump Shaft Oil Seal Replacement

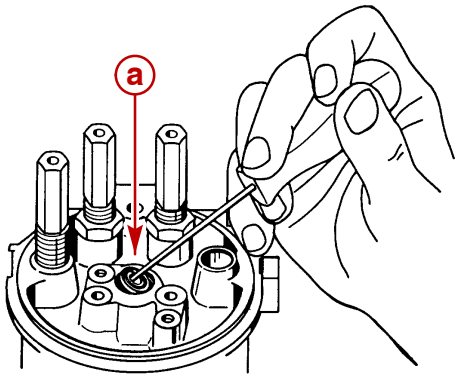
1. Remove the pump attaching screws with a hex lobular socket or standard 5 mm socket.
2. Remove pump. Do not loosen or remove the pump attaching screws.



70870

a - Screws
b - Pump attaching screws

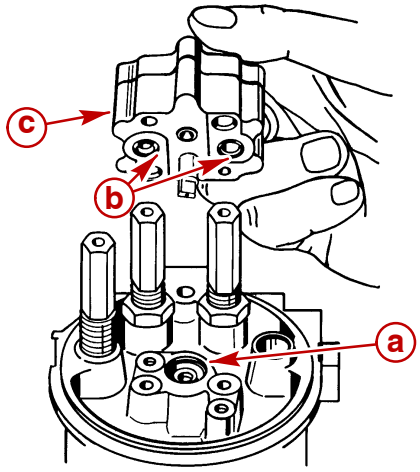
3. Remove the oil seal by prying out with a screwdriver.



50371

a - Oil seal

4. Remove and replace the O-rings on the pump base if they are worn.
5. Install a new seal with the lips toward the pump. The oil seal can be pressed in by hand.
6. Lubricate the lip of the seal with light weight oil.

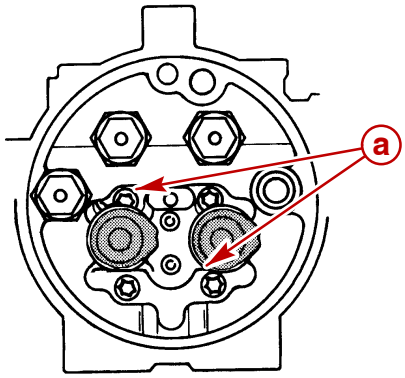


22545

a - Oil seal
b - O-rings
c - Pump

Description	Where Used	Part Number
Power Trim and Steering Fluid	O-ring at base on new valve	92-802880A1

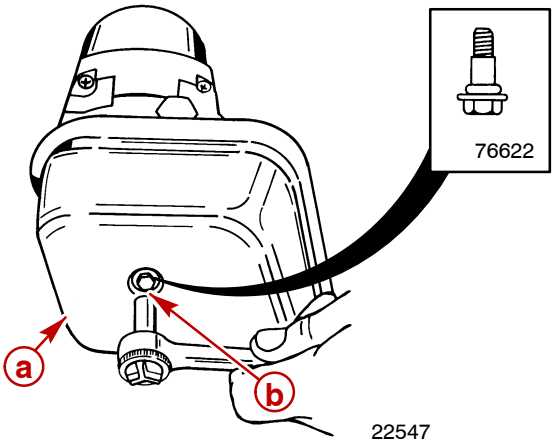
7. Install the pump. Torque the pump attaching screws using a hex lobular socket or standard 5 mm socket.



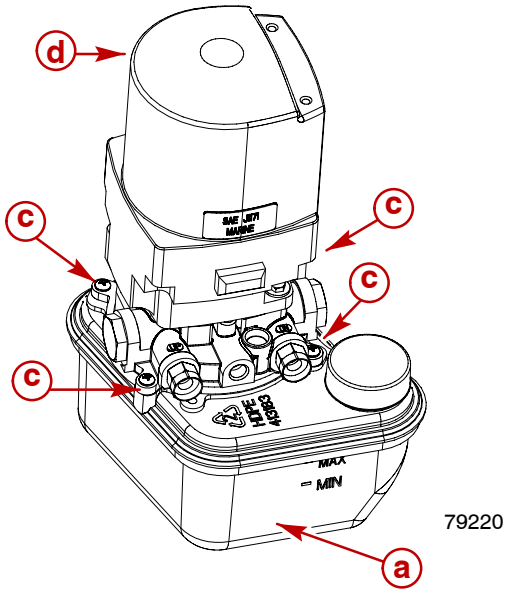
a - Pump attaching screws

Description	Nm	lb-in.	lb-ft
Pump attaching screws	8	75	

8. Install the pump reservoir.



Early model reservoir bottom mount



Later model reservoir top mount

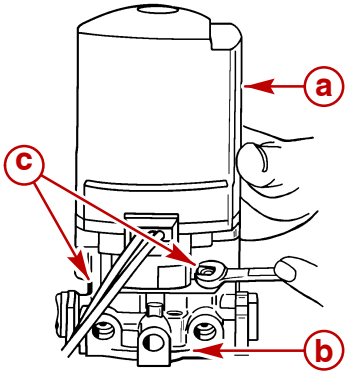
a - Pump reservoir
b - Bolt and O-ring (early model)
c - Top mount (4) screws (later model)
d - Pump motor

Description	Nm	lb-in.	lb-ft
Adapter to reservoir screws	3	27	

Motor Repair

Disassembly

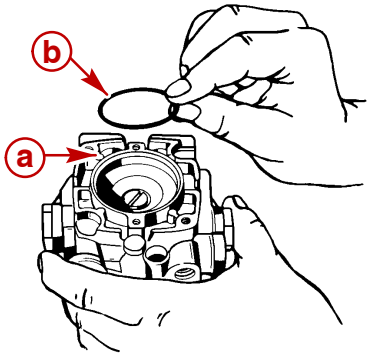
1. Remove the trim motor from the adapter.



70363

a - Trim motor
b - Adapter
c - Screws

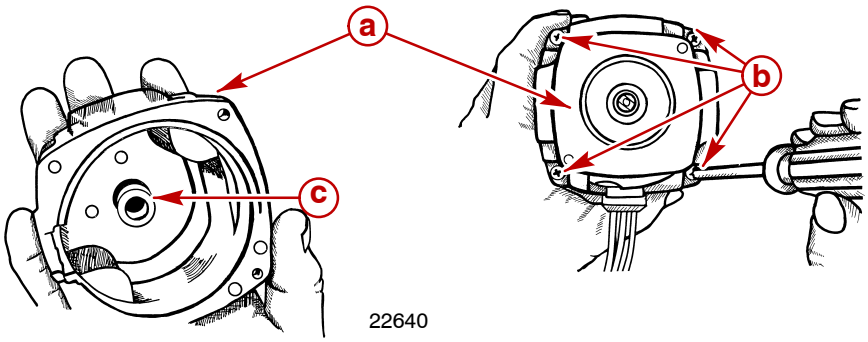
2. Remove the motor to adapter O-ring.



70600

a - Adapter
b - O-ring

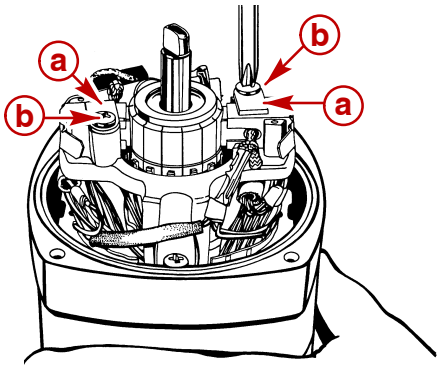
3. Remove the motor end cover and washer from the armature shaft.



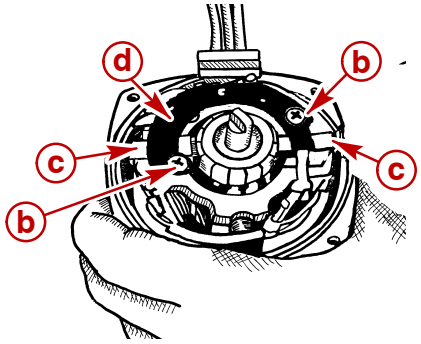
22640 22639

a - Cover
b - Screws (4)
c - Washer

4. Loosen the brush hold down arms.
5. **Later model:** Remove the circuit board plate.



22648



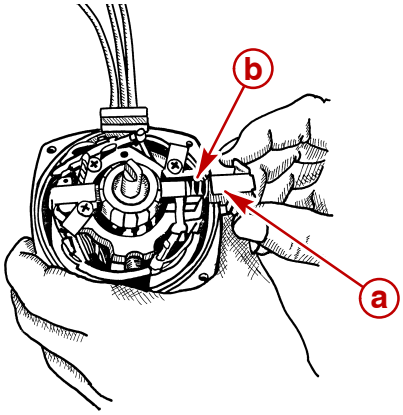
79219

Early model **Later model**

a - Brush hold down arms
b - Screws
c - Brush holders
d - Circuit board plate

IMPORTANT: Use care in removing brush holders so as not to lose springs.

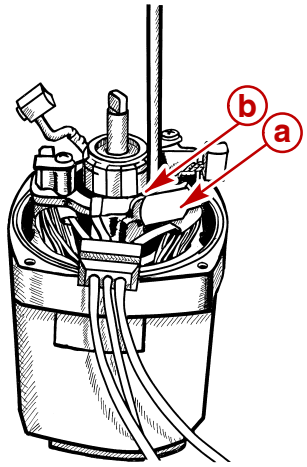
6. Remove the brush holders and springs.



22638

a - Brush holder
b - Spring

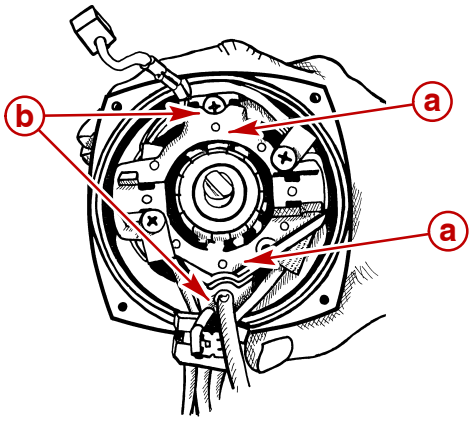
7. Remove the thermal switch and brush assembly.



22637

a - Thermal switch and brush
b - Screw

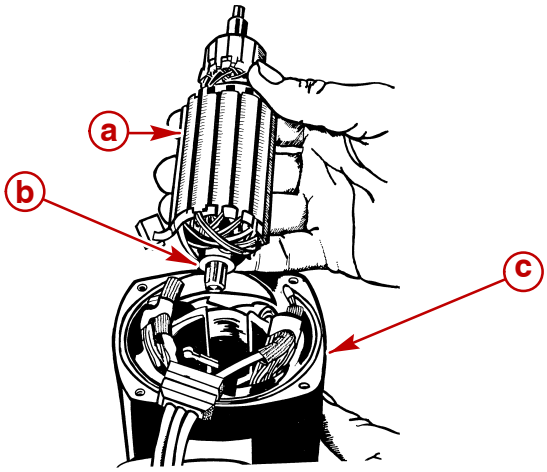
8. Remove the brush assembly mounting bracket.



22636

a - Brush assembly bracket
b - Screws

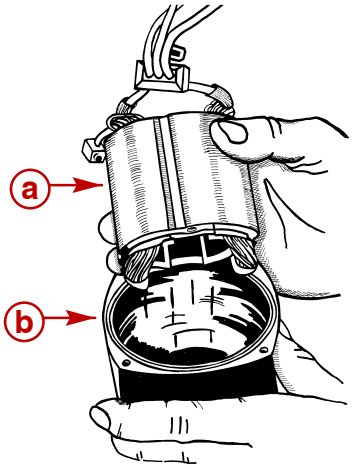
9. Remove the armature and thrust washer from the motor housing.



22499

a - Armature
b - Thrust washer
c - Motor housing

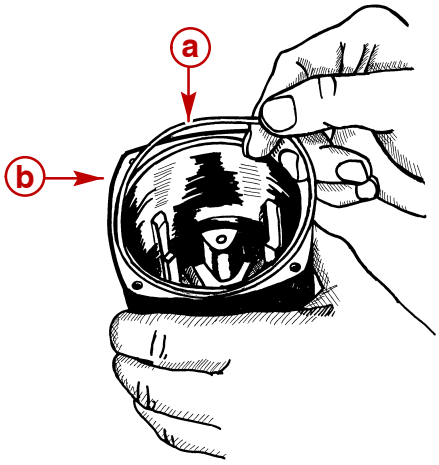
10. Remove the field assembly from the motor housing.



22501

a - Field assembly
b - Motor housing

11. Remove the motor housing O-ring.



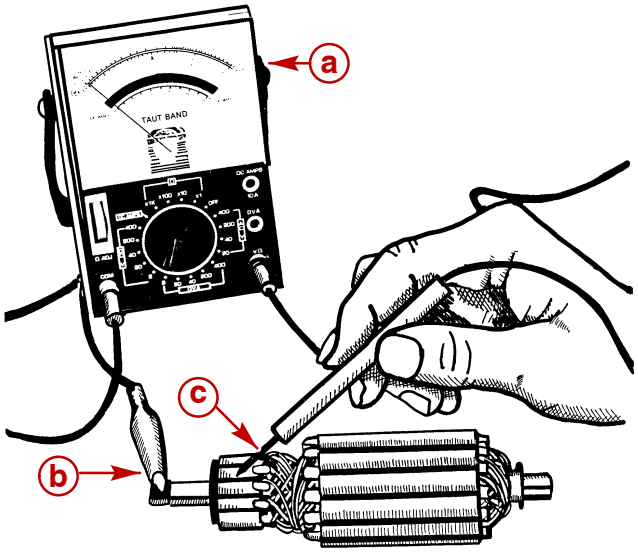
22645

a - O-ring
b - Motor housing

Armature Tests

Continuity Test

1. Set the ohmmeter on the Rx1 scale.
2. Place the alligator clip meter lead on the armature shaft.
3. Touch the meter lead probe to each commutator bar one at a time.



22646

a - Ohmmeter – Set on Rx1 Scale
b - Meter lead
c - Meter lead

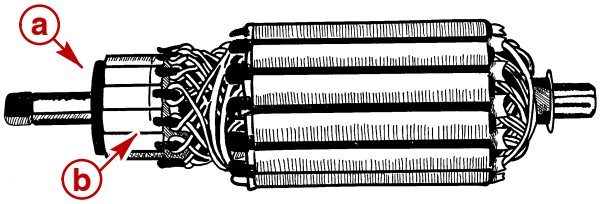
4. **Continuity Indicated -** Armature grounded (replace armature).
   Continuity Not Indicated - Armature not grounded.

Test For A Shorted Circuit

1. Check the armature on a growler (follow the growler manufacturers instructions). Replace the armature if it has a short.

Cleaning Commutator

1. Clean the commutator with “00” garnet grit sandpaper. Do not use emery paper.
2. Check the gaps between the commutator bars for material. Remove material if present.



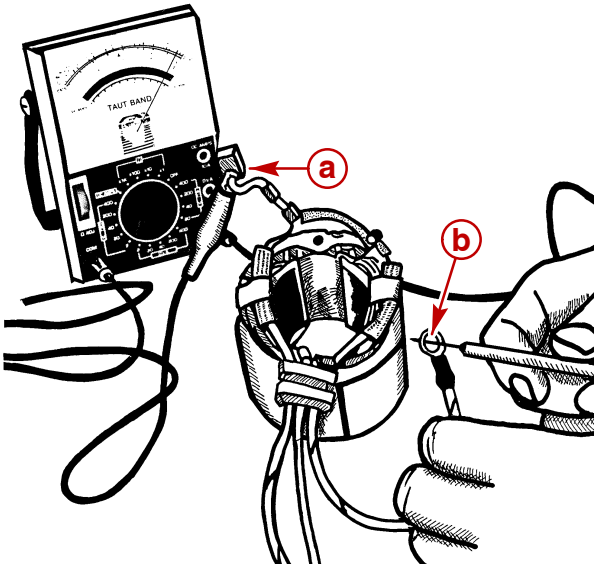
22647

a - Commutator
b - Gap

Field Tests

Test for Open Circuit

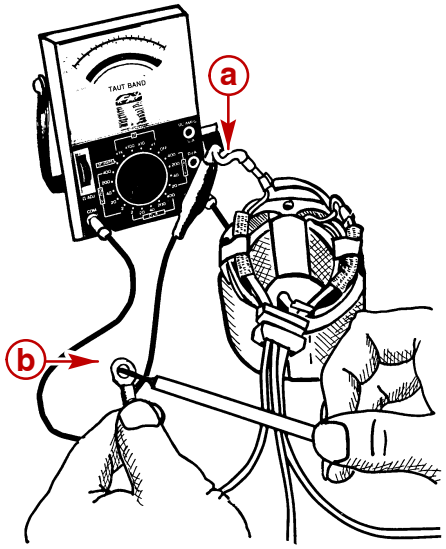
1. Connect the ohmmeter between the field brush lead and the BLUE/WHITE lead.



22644

a - Ohmmeter lead - connected to Brush lead
b - Ohmmeter lead - connected to BLUE/WHITE lead

2. **Zero ohms indicated** (full continuity) - Field OK.
   Zero ohms not indicated (no continuity) - Replace field assembly.
3. Connect the ohmmeter between the field brush lead and the GREEN/WHITE lead.



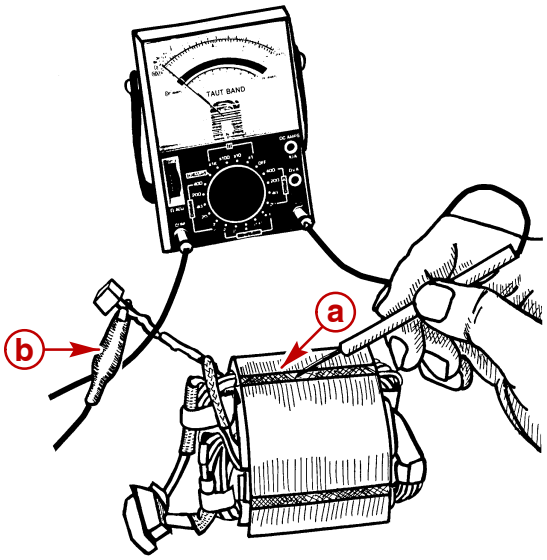
22642

a - Ohmmeter lead - connected to brush lead
b - Ohmmeter lead - connected to GREEN/WHITE lead

4. **Zero ohms indicated** (full continuity) - Field OK.
   Zero ohms not indicated (no continuity) - Replace field assembly.

Test for Shorted Circuit

1. Connect the ohmmeter between the field brush lead and the field frame.



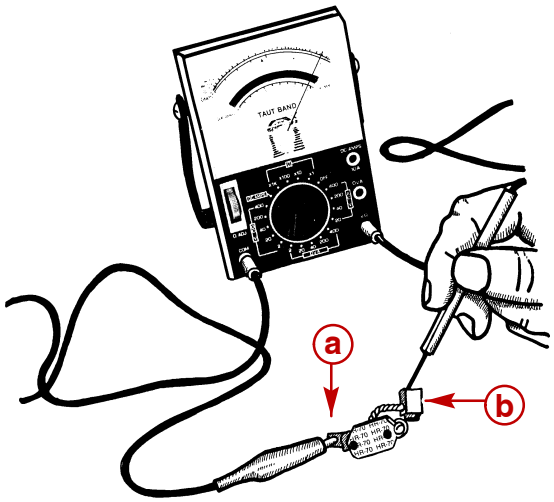
22643

a - Field frame
b - Field brush lead

2. **Zero ohms indicated** (full continuity) - Short indicated (replace field assembly).
   Zero ohms not indicated (no continuity) - Field OK.

Thermal Switch Continuity Test

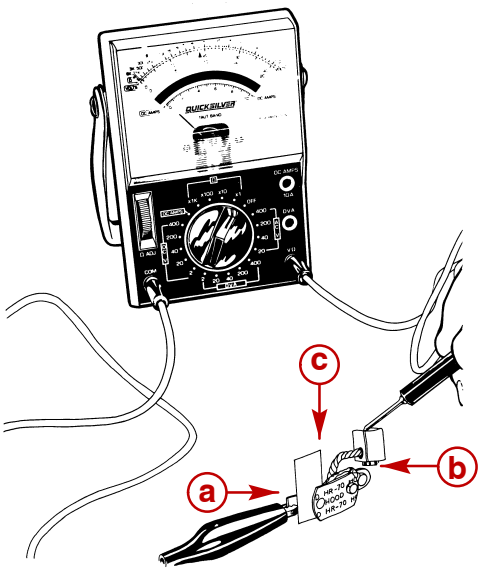
1. Connect the ohmmeter between the spade connector and the brush lead.



22631

a - Thermal switch spade connector
b - Brush lead

2. **Zero ohms indicated** (full continuity) - Proceed to next step.
   Zero ohms not indicated (no continuity) - Replace thermal switch.
3. Insert an insulator (piece of paper) between the contact points on the ohmmeter (between spade connector and brush lead).



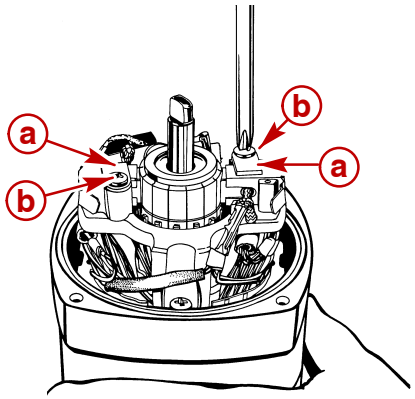
22649

a - Thermal switch spade connector
b - Brush lead
c - Insulator (piece of paper)

4. **Zero ohms indicated** (full continuity) -Replace thermal switch.
   Zero ohms not indicated (no continuity) - Thermal switch OK.
5. Remove the insulator from between the contact points on the thermal switch. Clear all material away from the points.

Brush Replacement

1. Loosen the brush hold down arms.

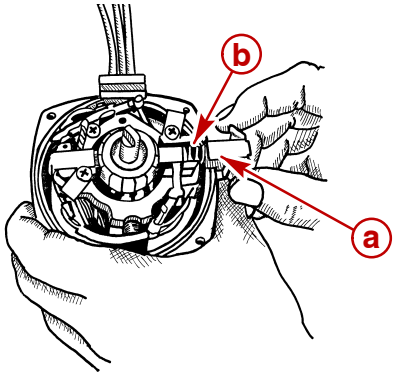


22648

a - Brush hold down arms
b - Screws

IMPORTANT: Use care in removing brush holders. Do not lose springs.

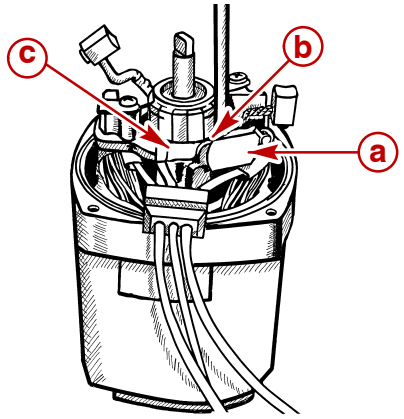
2. Remove the brush holders and springs.



22638

a - Brush holder
b - Spring

3. Remove the thermal switch and brush assembly.

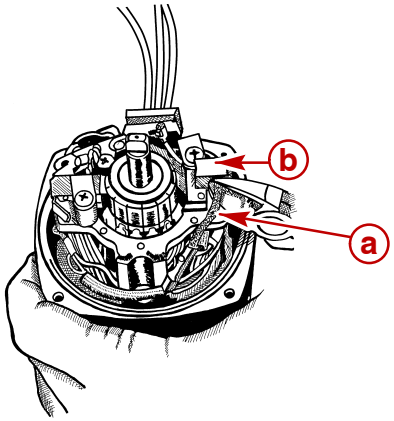


22637

a - Thermal switch and brush
b - Screw
c - Connector

IMPORTANT: When replacing the brush that is connected to the field wires, cut the brush wire as close to the brush as possible.

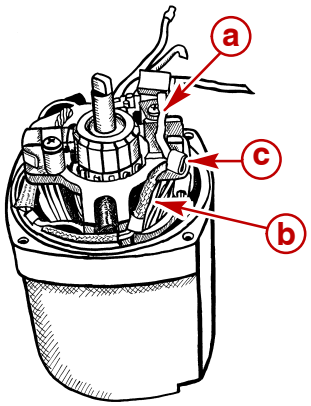
4. Cut the brush wire as close to the brush as possible and discard the brush.



22632

a - Brush wire
b - Brush

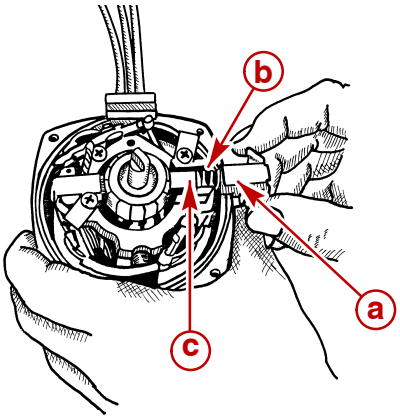
5. Connect the new brush wire to the field wire cut in the previous step. Secure by crimping both wires together as shown.



22635

a - Brush wire
b - Field wire (old brush wire)
c - Crimp connector

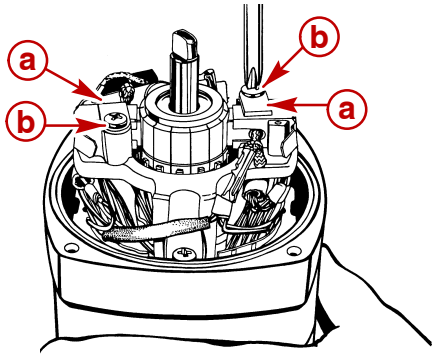
6. Reinstall the spring and brush in the brush holder.



22638

a - Brush holder
b - Spring
c - Brush

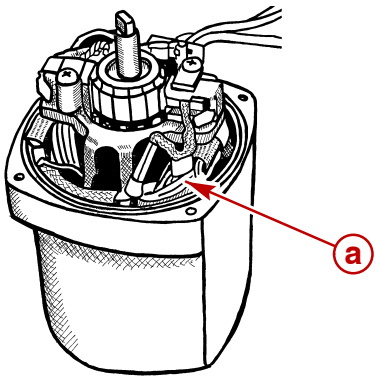
7. Position the brush hold down arms and tighten them securely. Do not overtighten.



22648

a - Brush hold down arms
b - Screws

8. Position the brush wire as shown before reassembly.

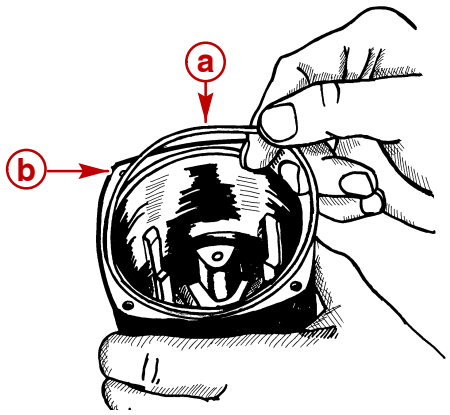


22634

a - Brush wire

Reassembly

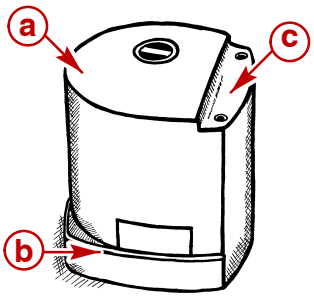
1. Install the motor housing O-ring.



22645

a - O-ring
b - Motor housing

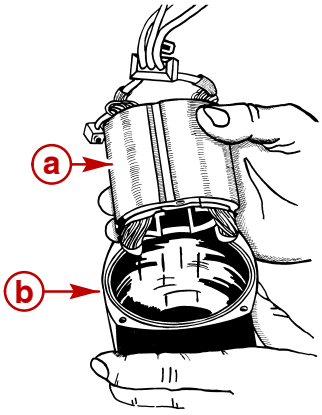
IMPORTANT: The field assembly wires must face the front of the motor housing. Use the notched area in the housing as a reference in determining the front.



22633

a - Motor housing
b - Front
c - Notched area

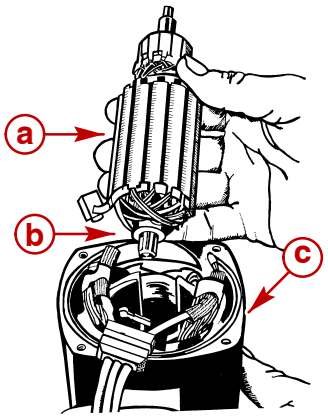
2. Install the field assembly into the motor housing.



22501

a - Field assembly
b - Motor housing

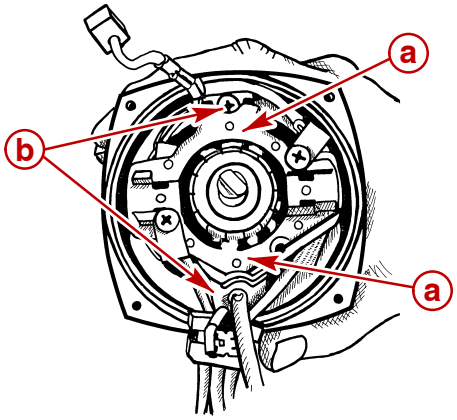
3. Install the thrust washer on the armature and install the armature into the motor housing.



22499

a - Armature
b - Thrust washer
c - Motor housing

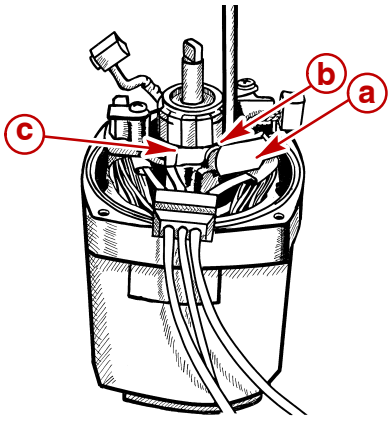
4. Install the brush assembly mounting bracket. Tighten the screws securely.



22636

a - Brush assembly mounting bracket
b - Screws

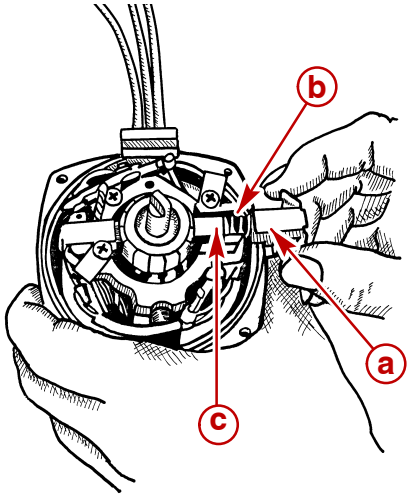
5. Install the thermal switch and connect the black wire. Do not overtighten the screw.



22637

a - Thermal switch
b - Screw
c - Black wire connector

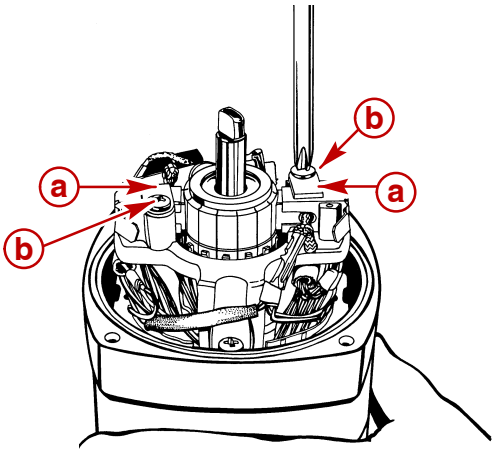
6. Install the springs and brushes in the brush holders.



22638

a - Brush holders
b - Springs
c - Brushes

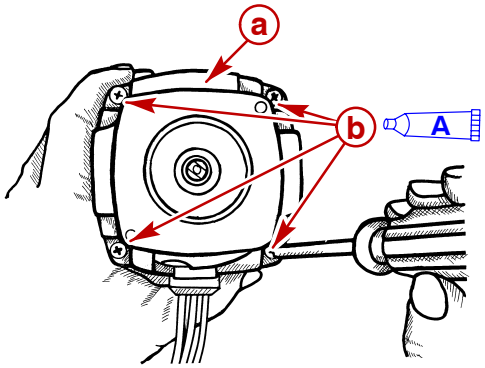
7. Position the brush holders and secure them with the brush hold down arms. Do not overtighten the screws.



22648

a - Brush hold down arms
b - Screws

8. Install the motor end cover. Apply sealant to the screws and tighten securely. Do not overtighten.

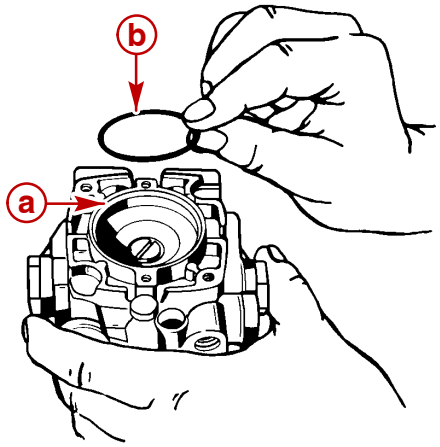


22639

a - Motor end cover
b - Screws

Description		Where Used	Part Number
A	Loctite 271 Threadlocker	Screws	92-809819

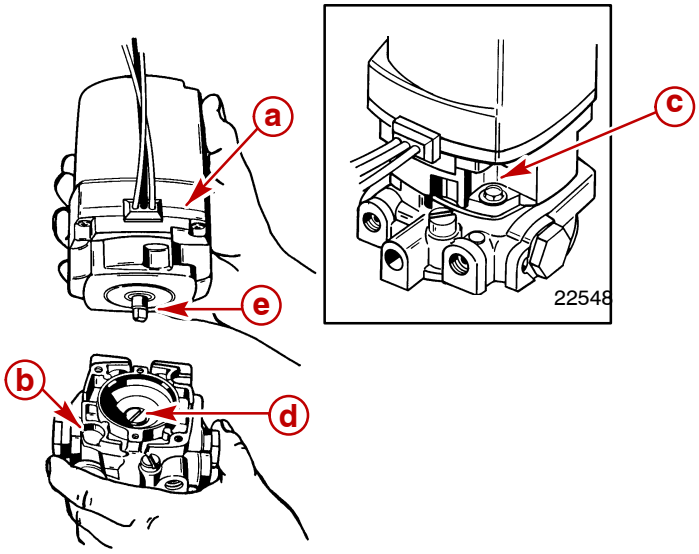
9. Install the motor to adapter O-ring.



70600

a - Adapter
b - O-ring

10. Align the motor shaft with the coupler and install the trim motor on the adapter. Torque the screws.

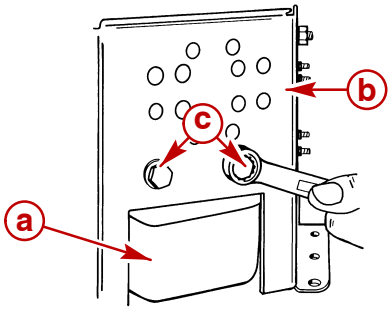


22496

a - Trim motor
b - Adapter
c - Screws (2 in opposite corners)
d - Coupler
e - Motor shaft

Description	Nm	lb-in.	lb-ft
Trim motor screws	2.8	25	

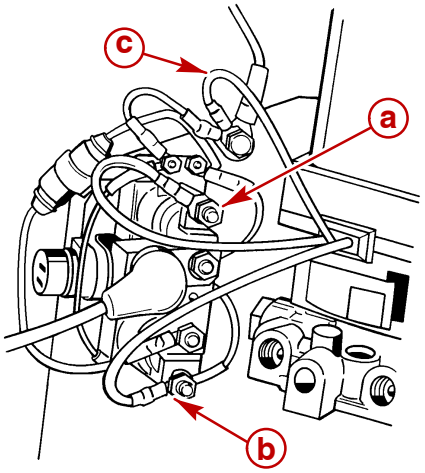
11. Install the trim pump on the dual mount bracket. Tighten securely.



22548

a - Trim pump
b - Floor bracket
c - Screws and lockwashers

12. Connect the trim motor wires to solenoids as shown.



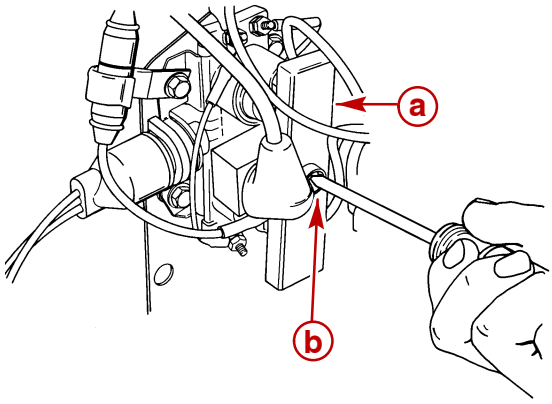
70359

a - BLUE/WHITE motor wire
b - GREEN/WHITE motor wire
c - BLACK ground wire

⚠ CAUTION

Solenoid terminal cover screw is attached to 12 volt positive source. Do not ground the screw driver when installing cover.

13. Install the solenoid terminal cover. Tighten the screw securely.



70360

a - Solenoid terminal cover
b - Screw Trim Pump Installation

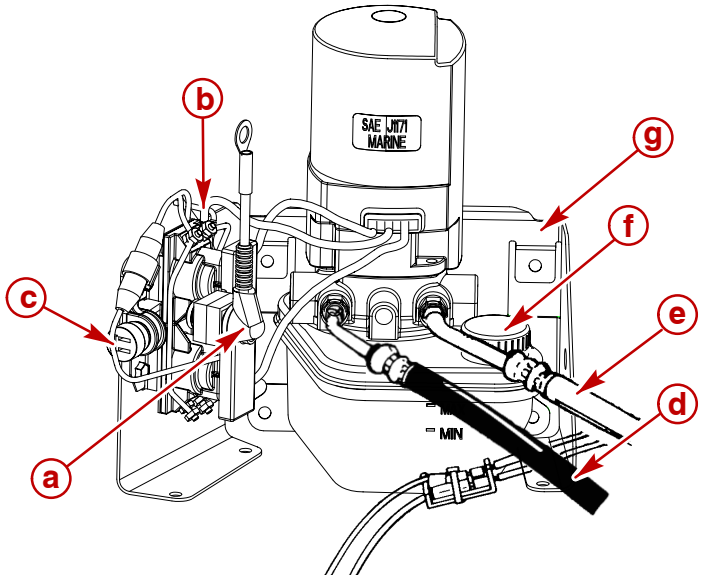
Installation

1. Secure the pump and mounting bracket to the boat using lag bolts and washers.
2. Reconnect the trim hoses to the pump; black hose to the left connection, gray hose to the right connection. Do not cross-thread or overtighten the hose fittings. Torque the fittings.
3. Reconnect the trim harness connector to the trim pump.
4. Reconnect trim pump leads to power source.

⚠ CAUTION

Fill cap is vented. Be sure to remove "Caplug" (fill neck seal) from fill neck on new replacement pumps. Failure to do this can damage pump, when operated.

5. Check the fluid level and fill if necessary. Refer to **Maintaining Power Trim Pump Oil Level** in this section).

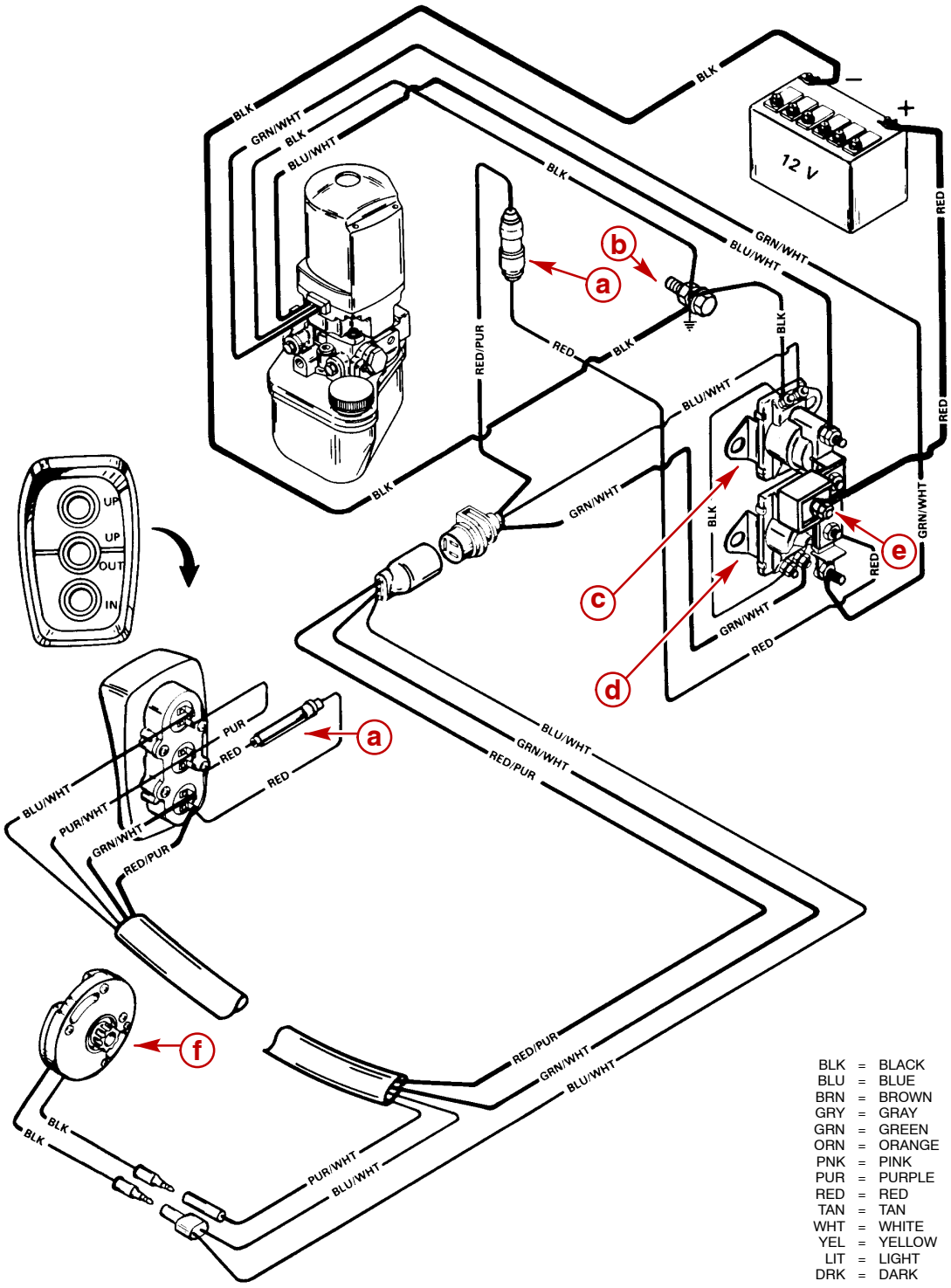


a - Positive battery lead
b - Negative battery lead
c - Harness connector
d - BLACK hydraulic hose (UP hose)
e - GRAY hydraulic hose (DOWN hose)
f - Vented fill cap
g - Dual mount trim pump bracket

Description	Nm	lb-in.	lb-ft
Hydraulic hose fittings	9	80	
Hydraulic hose adapter fittings	9	80	

Trim Pump Wiring Diagrams

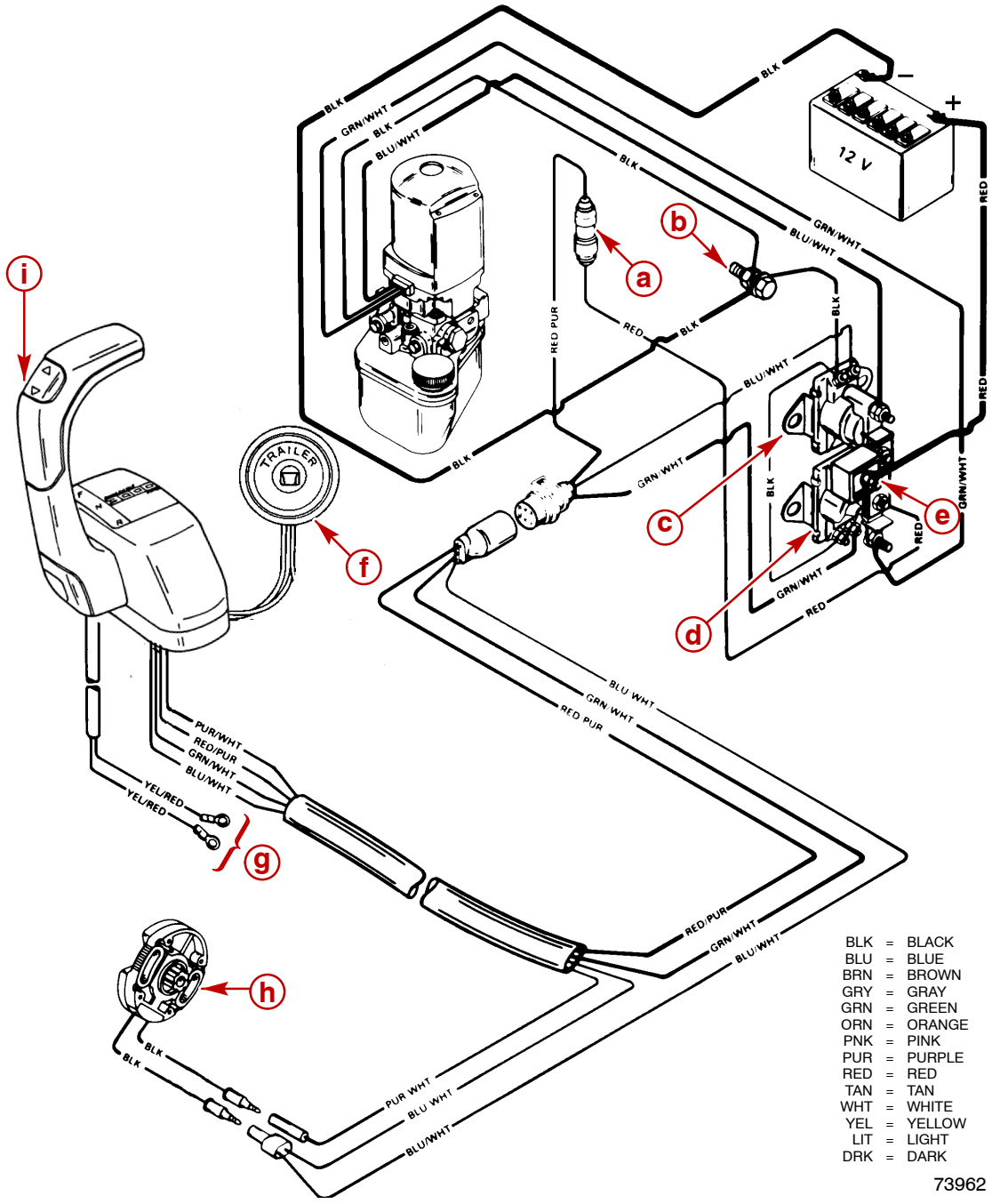
Model With Three-Button Trim/Trailer Panel



76894

a - 20 amp fuse
b - Ground bolt (floor mount)
c - Up solenoid
d - Down solenoid
e - 110 amp fuse
f - Trim limit switch

Model With Trim In Handle and Trailer Switch Separate



a - 20 amp fuse
b - Ground bolt (floor mount)
c - Up solenoid
d - Down solenoid
e - 110 amp fuse
f - Trailer switch
g - Neutral switch to instrument wiring harness
h - Trim limit switch
i - Trim buttons

NOTES:

POWER TRIM

Section 5B - Trim Cylinders

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5 B

Torque Specifications

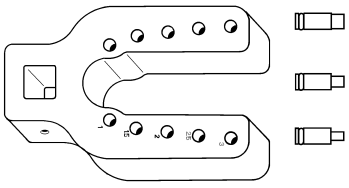
Description	Nm	lb-in.	lb-ft
Piston rod bolt	23		17
End cap	61		45
Trim cylinder hoses	11	100	

Lubricants / Sealants / Adhesives

NOTE: *Prior to reassembly of trim cylinders, lubricate all internal parts with Power Trim and Steering Fluid or, if not available, 10W-30 or 10W-40 motor oil.*

Description	Where Used	Part Number
Loctite 271 Threadlocker	Threads of piston rod bolt	92-809819
Power Trim and Steering Fluid	All internal parts	92-802880A1
2-4-C with Teflon	End cap threads	92-802859A1
	Anchor pin threads	

Special Tools

Spanner Wrench		
 71233	Removes trim cylinder end cap on all Mercury MerCruiser trim cylinders. Uses interchangeable pin sets: 91-811907 Large pin set: 0.235 in.(5.97 mm) 91-811908 Medium pin set: 0.180 in. (4.57 mm) 91-811909 Small pin set: 0.150 in.(3.81 mm)	91-821709T

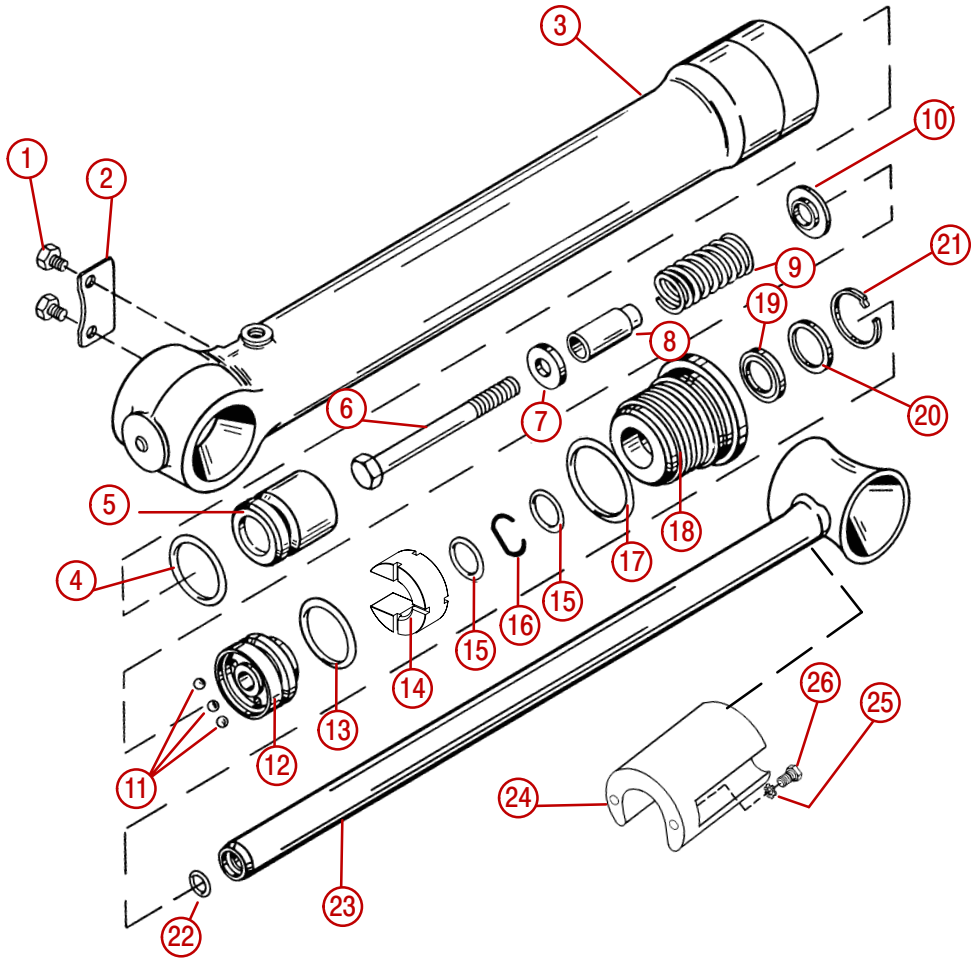
Tools

Description	Part Number
Inverted Flare Plug	22-38609

Exploded Views

Bravo Trim Cylinders

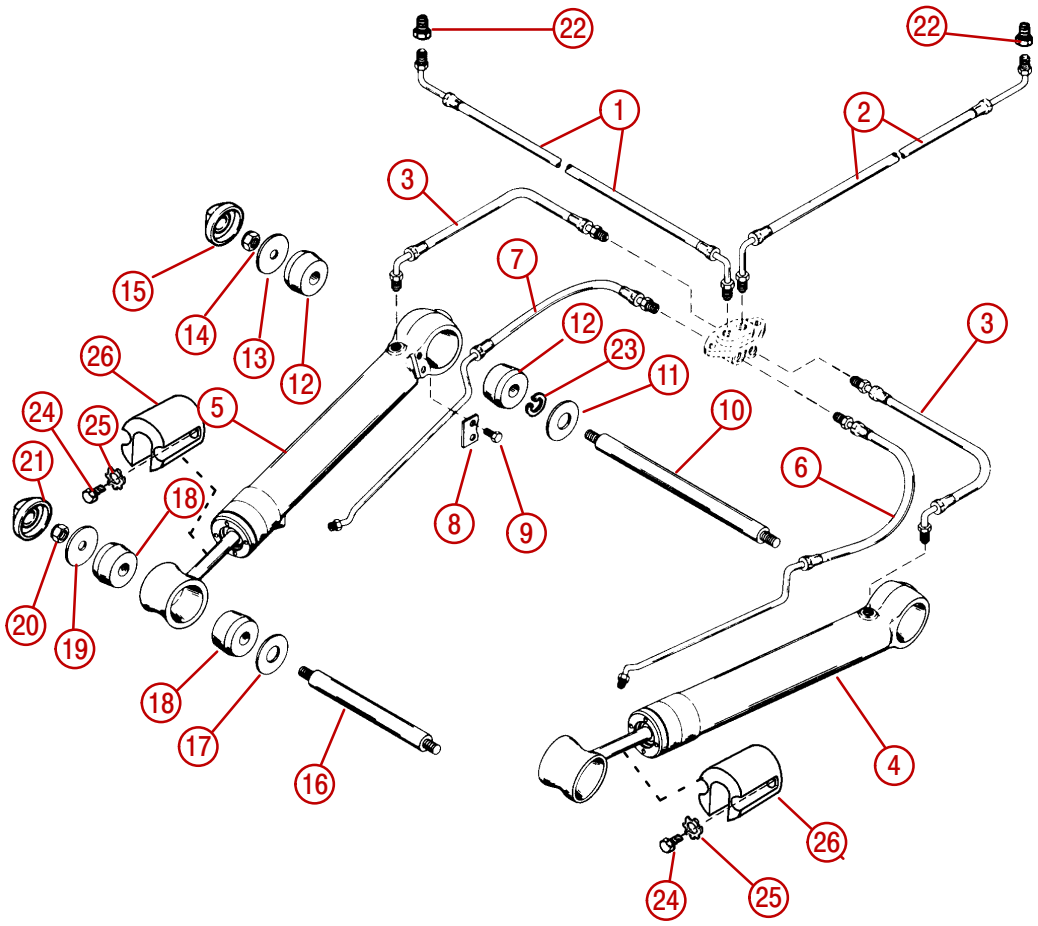
NOTE: *Prior to reassembly of trim cylinders, lubricate all internal parts with Power Trim and Steering Fluid or, if not available, 10W-30 or 10W-40 motor oil.*



76676

1 - Screws
2 - Clamping plate
3 - Trim cylinder
4 - O-ring
5 - Floating piston
6 - Bolt
7 - Washer
8 - Spring guide
9 - Spring
10 - Spring guide washer
11 - Check balls
12 - Shock piston
13 - O-ring
14 - Tilt limit spacer
15 - Small O-ring
16 - Continuity spring
17 - Large O-ring
18 - End cap
19 - Rod scraper
20 - Washer
21 - Retaining ring
22 - Small O-ring
23 - Piston rod
24 - Anode
25 - Star washer
26 - Screw

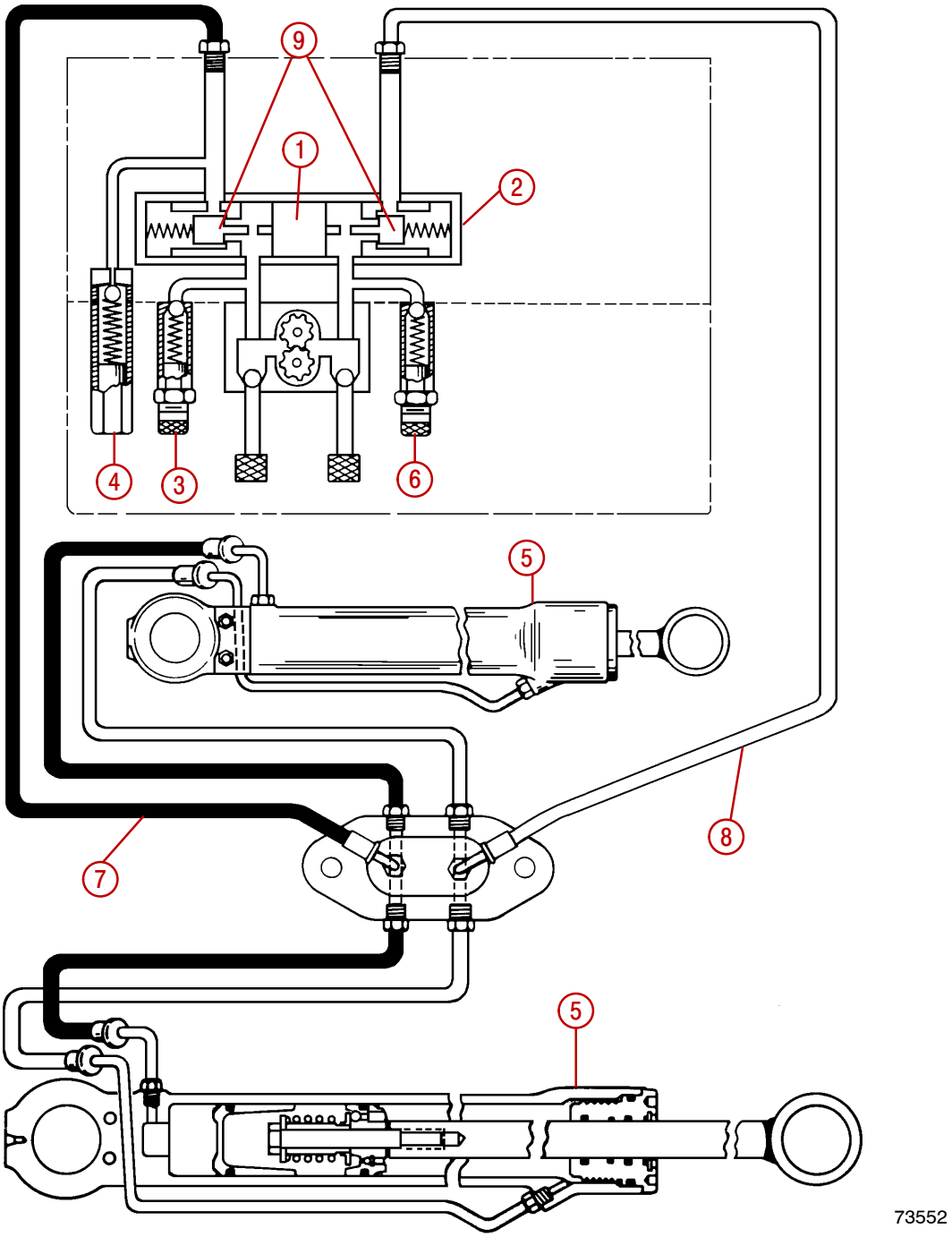
Bravo Trim System Components



73554

1 - IN/DOWN hose to trim pump (gray)
2 - OUT/UPhose to trim pump (black)
3 - OUT/UP hose to trim cylinder
4 - Starboard trim cylinder
5 - Port trim cylinder
6 - IN/DOWN starboard trim cylinder hose
7 - IN/DOWN port trim cylinder hose
8 - Plate
9 - Screw
10 - Front pin
11 - Washer
12 - Bushing
13 - Washer
14 - Nut
15 - Cap
16 - Rear pin
17 - Washer
18 - Bushing
19 - Washer
20 - Nut
21 - Cap
22 - Connector (trim pump)
23 - Retainer
24 - Screw
25 - Continuity washer
26 - Trim cylinder anode

Power Trim Hydraulic Schematic



1 - Shuttle
2 - Pump adaptor
3 - OUT/UP pressure relief valve
4 - Thermal relief valve
5 - Trim cylinder
6 - IN/DOWN pressure relief valve
7 - OUT/UP hose
8 - IN/DOWN hose
9 - Poppet valves

Special Information

Bravo Three Notice: Trim-In Limit Insert

Some boats, predominantly deep-Vee heavy boats, will roll up on their side under certain specific operating conditions. The roll can be either to port or starboard and may be experienced while moving straight ahead or while making a turn. The roll occurs most frequently at or near maximum speed, with the sterndrive unit trimmed at or near full IN. While the boat will not roll completely over, the roll may be sufficient to unseat the operator or passengers, and thereby create an unsafe situation.

The roll is caused by stern lift. Stern lift can be created by excessive sterndrive unit trim In. Under these extreme stern lift/bow down conditions, instability can be created which may cause the boat to roll. Weight distribution to the stern can reduce stern lift and, in some circumstances, eliminate the condition. Weight distribution in the bow, port or starboard, may worsen the condition.

The Trim-In Limit devices reduce stern lift by preventing the sterndrive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, they may not eliminate the tendency entirely. The need for the Trim-In Limit Insert, and the effectiveness of them, can only be determined through boat testing and is ultimately the responsibility of the boat manufacturer.

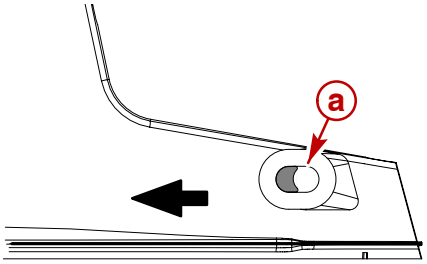
⚠ WARNING

It is recommended that only qualified personnel adjust the Trim-In Limit Insert. Boat must be water tested after adjusting the device to ensure that the modified trim IN range does not cause the boat to exhibit an undesirable boat handling characteristic if the sterndrive unit is trimmed IN at higher speeds. Increased trim IN range may cause handling problems on some boats which could result in personal injury.

IMPORTANT: On Bravo One, Two, and Three Models, the Trim-In Limit Insert must be properly positioned before installing the trim cylinder anchor pin in the following steps.

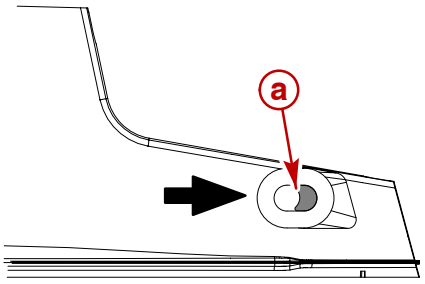
NOTE: *When removing the sterndrive unit, make a note of the position of the insert for reference when reinstalling the sterndrive unit.*

1. If equipped, ensure that the Trim-In Limit Insert is positioned as shown for the appropriate Bravo model.



75157

Bravo One and Two (positioned forward)



75158

Bravo Three (positioned aft)

a - Trim-in limit insert

IMPORTANT: The position of the Trim-In Limit Insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

Trim Cylinder Internal Leak Test

Refer to **Section 5A - Power Trim Pump**.

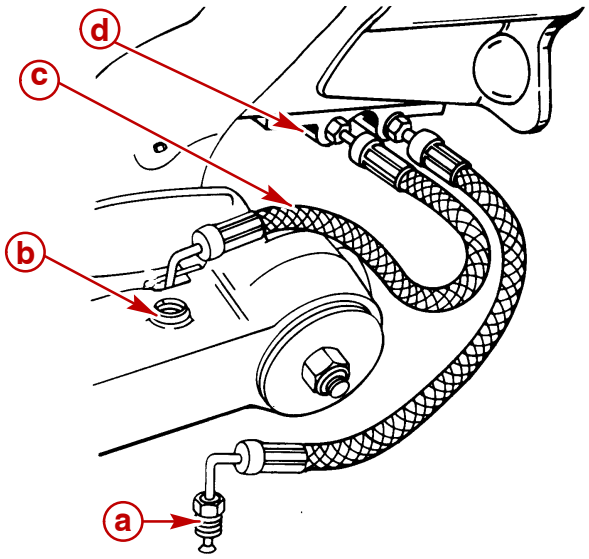
Trim Cylinder Shock Piston Test

Refer to **Section 5A - Power Trim Pump**.

Trim Cylinder Repair

Removal

1. Disconnect OUT/UP trim hose from front hole on trim cylinder.
2. Disconnect IN/DOWN trim hose from hydraulic connector on gimbal housing.
3. Plug holes with inverted flare or suitable plug.
4. Cap hoses.

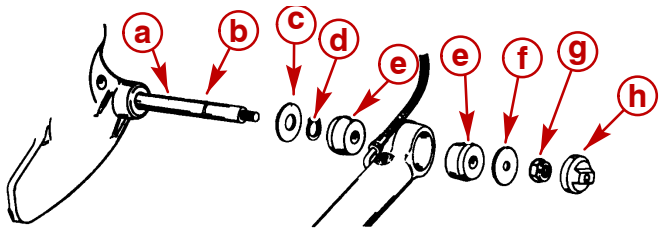


50389

a - OUT/UP hose
b - Front hole on trim cylinder
c - IN/DOWN hose
d - Hydraulic connector

Description	Part Number
Inverted Flare Plug	22-38609

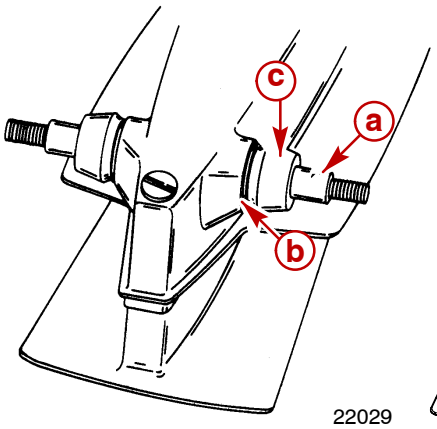
5. Remove front and rear power trim cylinder mounting hardware.



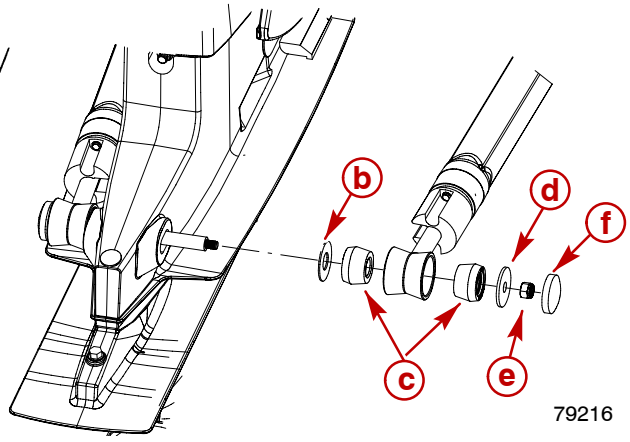
71489

Front

- **a** - Anchor pin (1)
- **b** - Slots (2)
- **c** - Flat washer (large ID) (2)
- **d** - Snap rings (2)
- **e** - Bushings (4)
- **f** - Flat washer (small ID) (2)
- **g** - Locknut (2)
- **h** - Plastic cap (2)



22029



79216

Rear

- **a** - Rear anchor pin
- **b** - Large ID washers (port and starboard)
- **c** - Bushings (2) (port and starboard)
- **d** - Small ID washers (port and starboard)
- **e** - Locknuts (port and starboard)
- **f** - Plastic caps (port and starboard)

Disassembly

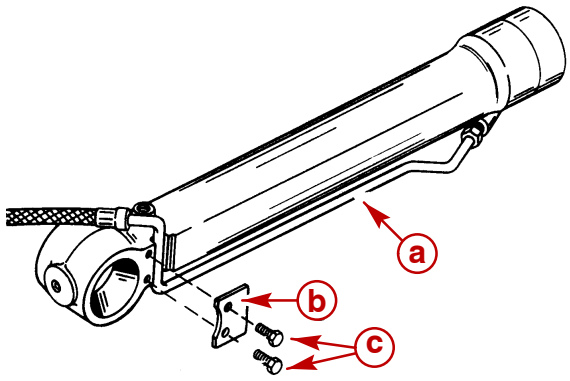
⚠ CAUTION

Ensure work area is clean before disassembling power trim cylinders. Cylinder parts can be damaged by dirt entering into power trim system.

⚠ CAUTION

Do not clamp center section of power trim cylinder during assembly or disassembly. Clamp cylinder on front mounting flange.

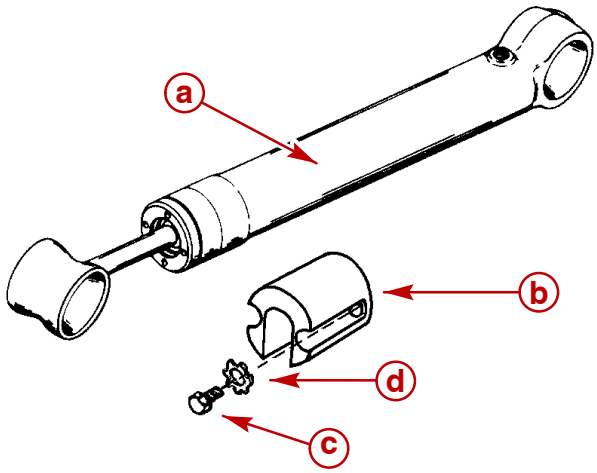
1. Remove IN/DOWN trim hose from cylinder.



22134

a - IN/DOWN trim hose
b - Clamping plate
c - Screws

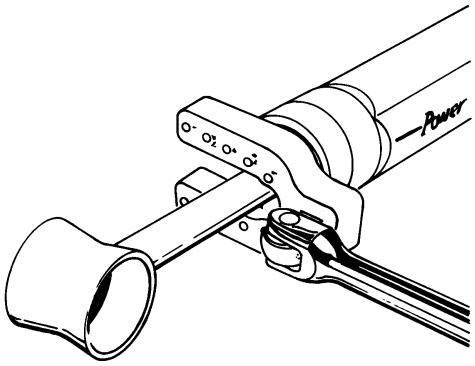
2. Remove trim cylinder anodes.



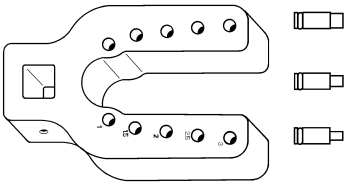
76902

a - Trim cylinder
b - Trim cylinder anode
c - Screw (2)
d - Washer (2)

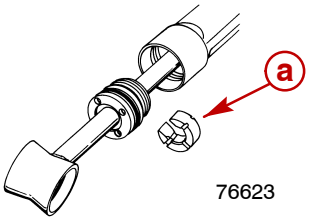
3. Use Spanner Wrench to remove trim cylinder end caps.



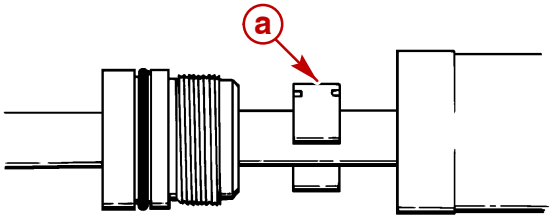
71677

Spanner Wrench		
 71233	Removes trim cylinder end cap on all Mercury MerCruiser trim cylinders. Uses interchangeable pin sets: 91-811907 Large pin set: 0.235 in.(5.97 mm) 91-811908 Medium pin set: 0.180 in. (4.57 mm) 91-811909 Small pin set: 0.150 in.(3.81 mm)	91-821709T

4. Remove tilt limit insert.



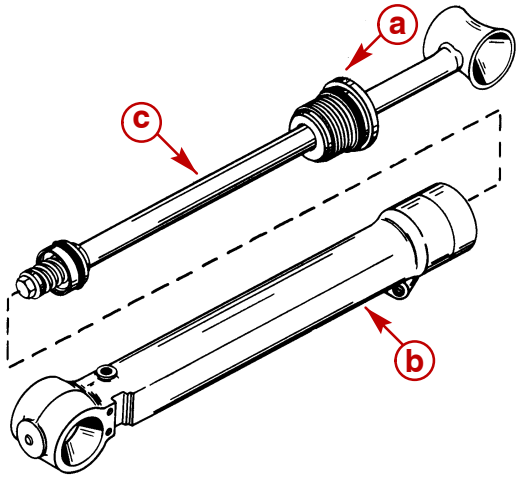
76623



76624

a - Tilt limit insert

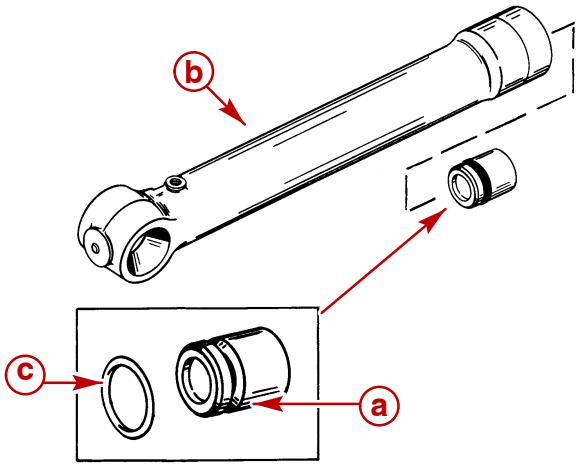
5. Remove piston rod assembly from cylinder.



22133

a - End cap
b - Cylinder
c - Piston rod assembly

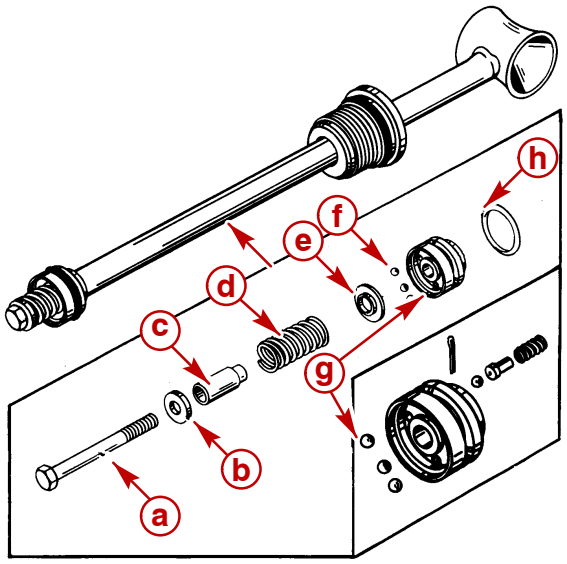
6. Remove floating piston from cylinder and remove O-ring by tapping cylinder on block of wood.



22131

a - Floating piston
b - Trim cylinder
c - O-ring

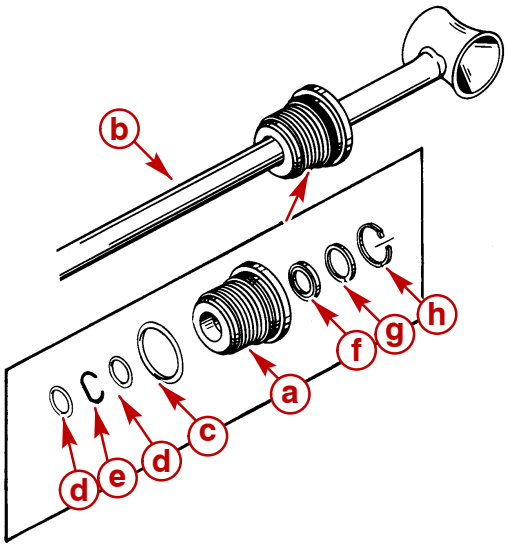
7. Disassemble shock piston assembly. Ensure that check balls are not lost.



22132

a - Bolt
b - Flat washer
c - Spring guide
d - Spring
e - Spring guide washer
f - Check balls (3)
g - Shock piston assembly
h - O-ring

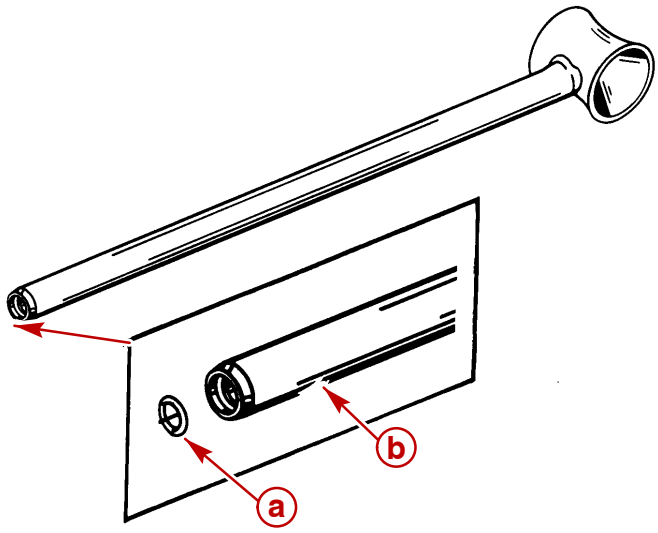
8. Remove and disassemble end cap.



22133

a - End cap
b - Piston rod
c - Large O-ring
d - Small O-ring (2)
e - Continuity spring
f - Rod scraper
g - Plain washer
h - Retaining ring

9. Remove small O-ring from end of piston rod.



22132

a - Small O-ring
b - Piston rod

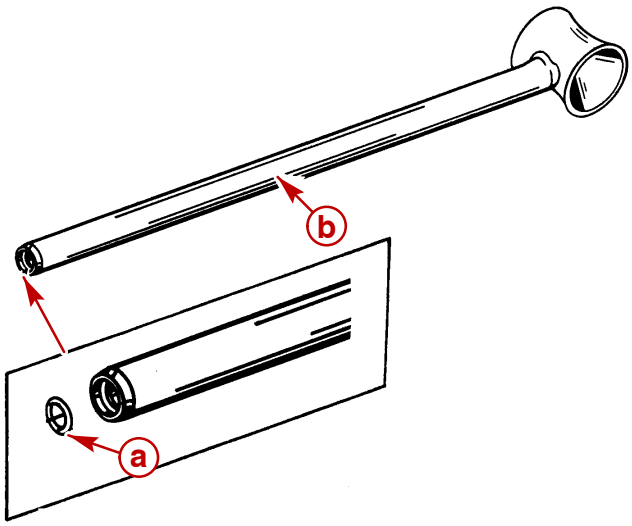
10. Clean all parts in solvent. Ensure all parts are dry before reassembly.

Reassembly

⚠ CAUTION

Ensure that work area and all components are clean before reassembling trim cylinders. Power trim components can become damaged if dirt gets into system.

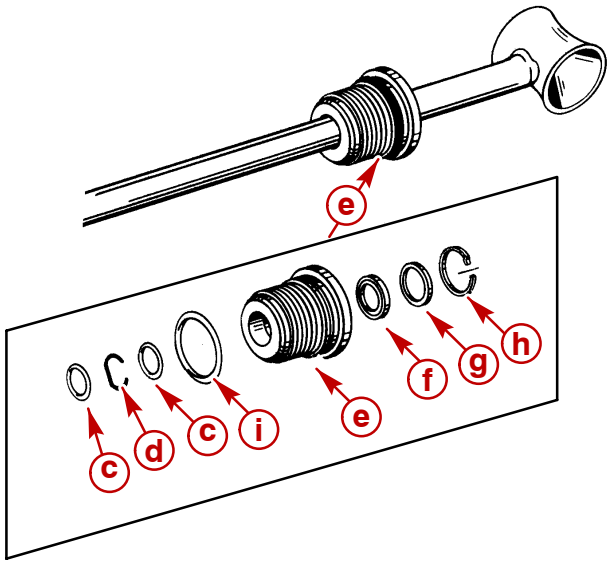
1. Install small O-ring into end of piston rod.



22132

a - Small O-ring
b - End of piston rod

2. Install small O-rings and continuity spring into end cap.
3. Install rod scraper, plain washer, and retaining ring into end cap.
4. Install large O-ring onto outside diameter of end cap.
5. Install end cap onto piston rod.

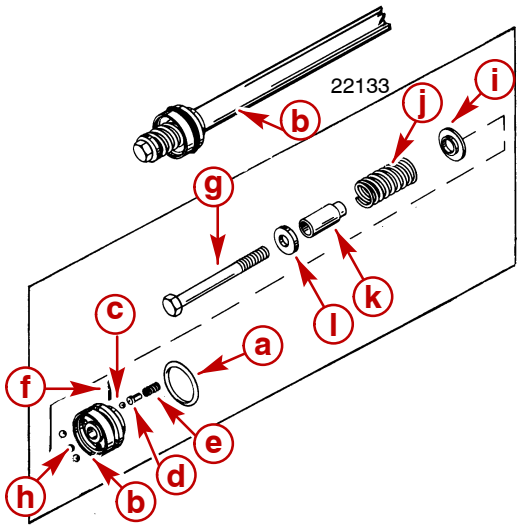


22133

22132

a - Small O-rings
b - Continuity spring
c - End cap
d - Rod scraper
e - Plain washer
f - Retaining ring
g - Large O-ring

6. Install large O-ring on shock piston.
7. Install shock piston, three check balls, check ball eyelet, spring guide washer, spring, spring guide, spring guide washer and bolt onto piston rod.
8. Apply sealant to threads of piston rod bolt and torque.



22132

a - Large O-ring
b - Shock piston
c - Check ball
d - Check ball eyelet
e - Spring
f - Spring pin
g - Bolt
h - Check balls
i - Spring guide washer
j - Spring
k - Spring guide
l - Spring guide washer

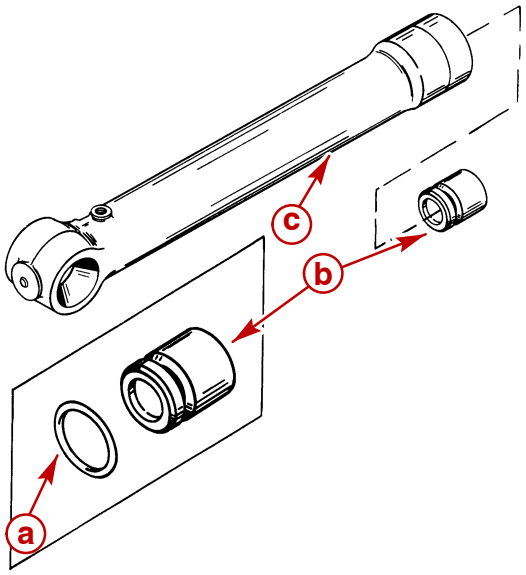
Description	Where Used	Part Number
Loctite 271 Threadlocker	Threads of piston rod bolt	92-809819

Description	Nm	lb-in.	lb-ft
Piston rod bolt	23		17

NOTE: *Before reassembly, lubricate all internal parts with Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil.*

9. Apply lubricant to parts.

10. Install O-ring onto floating piston and insert floating piston into cylinder.



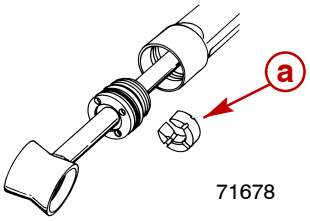
22132

a - O-ring
b - Floating piston
c - Cylinder

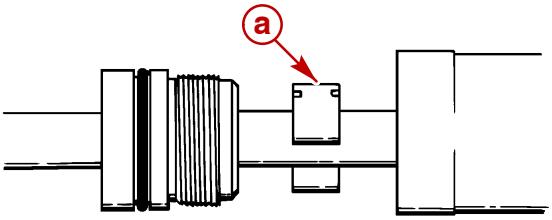
Description	Where Used	Part Number
Power Trim and Steering Fluid	All internal parts	92-802880A1

IMPORTANT: Some boat configurations may require tilt-limit inserts to limit the total upward travel of the sterndrive unit. Be sure to install the same number of inserts that were originally removed. There must be an equal number in each cylinder.

11. If required, install tilt-limit inserts.



71678



71679

a - Tilt-limit inserts

⚠ CAUTION

Ensure that work area and all components are clean before reassembling trim cylinders. Power trim components can become damaged if dirt gets into system.

⚠ CAUTION

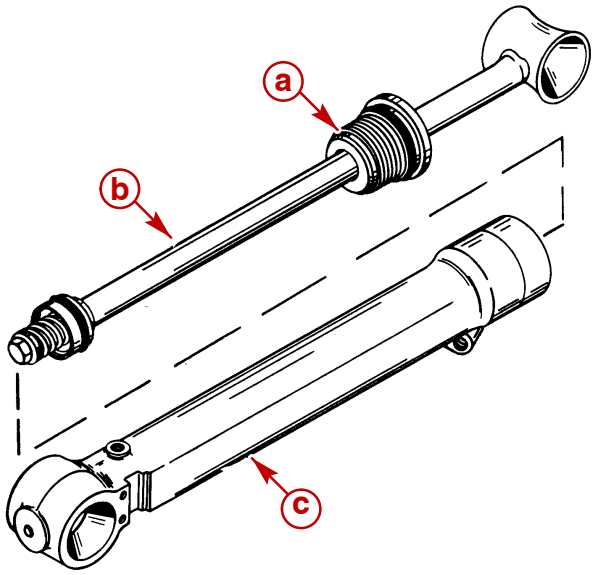
Do not clamp center section of trim cylinder during reassembly. If clamping of cylinder is necessary, clamp cylinder on front mounting flange.

⚠ CAUTION

Use only 2-4-C with Teflon on end cap threads. Other substances may act as an insulator and cause poor electrical continuity between cap and cylinder which could cause a corrosion problem.

NOTE: *Before reassembly, lubricate all internal parts with Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil.*

12. Apply lubricant to end cap threads and install piston rod assembly into cylinder.

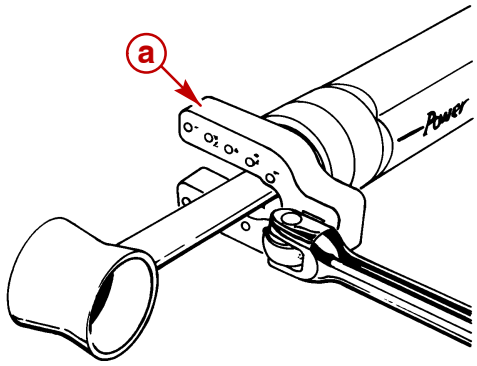


22133

a - End cap
b - Piston rod
c - Cylinder

Description	Where Used	Part Number
2-4-C with Teflon	End cap threads	92-802859A1

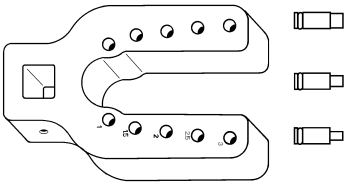
13. Using Spanner Wrench, torque end cap.



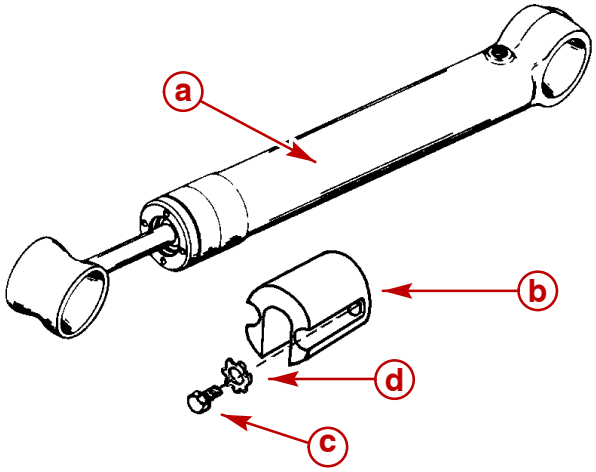
71677

a - Spanner Wrench

Description	Nm	lb-in.	lb-ft
End cap	61		45

Spanner Wrench		
 71233	Removes trim cylinder end cap on all Mercury MerCruiser trim cylinders. Uses interchangeable pin sets: 91-811907 Large pin set: 0.235 in.(5.97 mm) 91-811908 Medium pin set: 0.180 in. (4.57 mm) 91-811909 Small pin set: 0.150 in.(3.81 mm)	91-821709T

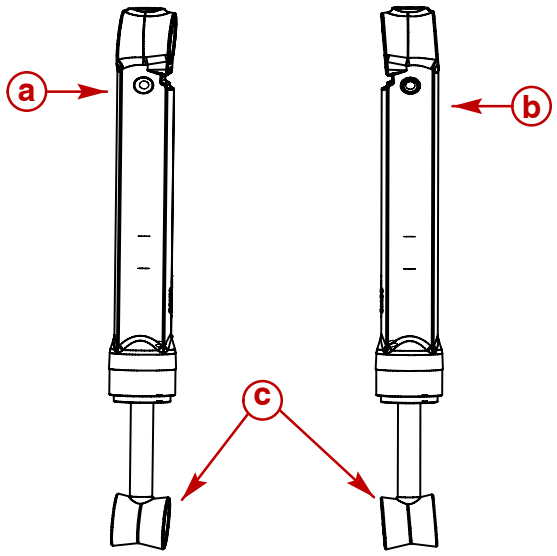
14. Install trim cylinder anodes.



76902

a - Trim cylinder
b - Trim cylinder anode
c - Screw (2)
d - Washer (2)

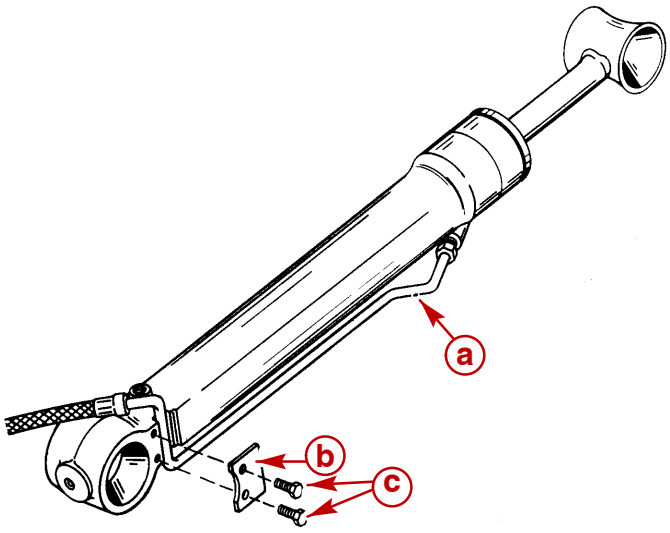
15. Position trim cylinder rear connecting ends as shown.



78880

a - Port trim cylinder
b - Starboard trim cylinder
c - Connecting ends (angled as shown)

16. Install IN/DOWN trim hose and torque.



22130

a - Down trim hose
b - Clamping plate
c - Screws

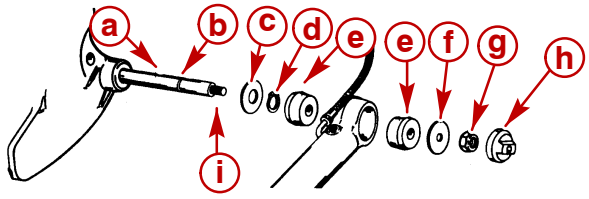
Description	Nm	lb-in.	lb-ft
Trim cylinder hoses	11	100	

17. Check painted areas of trim cylinders for scratches that expose metal and paint if necessary.

Installation

NOTE: *Refer to Special Information at the front of this section before reinstalling trim cylinders.*

1. Install trim cylinder forward mounting hardware as shown.
2. Lubricate anchor pin threads to prevent threads from galling.
3. Hand thread locknuts onto pin. Do not tighten at this time.



71489

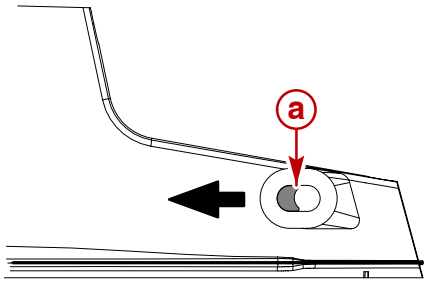
a - Anchor pin (1)
b - Slots (2)
c - Flat washer (large ID) (2)
d - Snap rings (2)
e - Bushings (4)
f - Washers (small ID) (2)
g - ocknut (2)
h - Plastic cap (2)
i - Anchor pin threads

Description	Where Used	Part Number
2-4-C with Teflon	Anchor pin threads	92-802859A1

IMPORTANT: <u>On Bravo One, Two, and Three Models</u> the Trim-In Limit Insert , must be properly positioned before installing the trim cylinder anchor pin in the following steps.

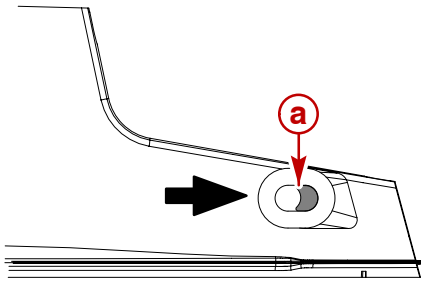
NOTE: *Ensure that the Trim-In Limit Insert is reinstalled in the same position that it was in prior to removal of the sterndrive unit. If you are not sure of the original position, contact the boat manufacturer for their recommendation. Refer to Special Information at the front of this section before reinstalling the Trim-In Limit Insert.*

4. Ensure that the Trim-In Limit Insert is positioned as shown for the appropriate Bravo model.



75157

Bravo One and Two (positioned forward)



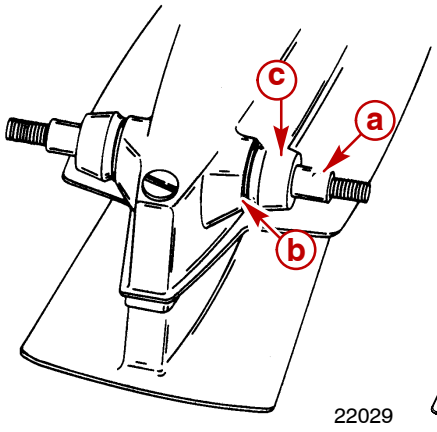
75158

Bravo Three (positioned aft)

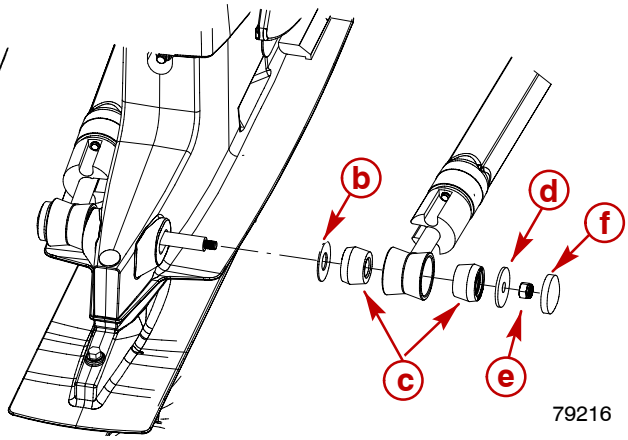
a - Trim-in limit insert

IMPORTANT: The position of the Trim-In Limit Insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

5. Install trim cylinder aft mounting hardware as shown.
6. Lubricate anchor pin threads to prevent threads from galling.
7. Hand thread locknuts onto anchor pin.



22029



79216

a - Rear anchor pin
b - Large ID washers (port and starboard)
c - Bushings (2) (port and starboard)
d - Small ID washers (port and starboard)
e - Locknuts (port and starboard)
f - Plastic caps (port and starboard)

Description	Where Used	Part Number
2-4-C with Teflon	Anchor pin threads	92-802859A1

⚠ CAUTION

All 4 anchor pin locknuts must be tightened as described following or damage to sterndrive unit may result from sterndrive unit moving too far inward.

8. Tighten the anchor pin locknuts until nuts and washers contact anchor pin shoulder.
9. Install plastic caps.
10. Reconnect OUT/UP trim hose to the trim cylinder and torque.

Description	Nm	lb-in.	lb-ft
Trim cylinder hoses	11	100	

11. Reconnect trim hoses to the connector after air bleeding power trim cylinders and hoses following procedures outlined in **Section 5A**.

Description	Nm	lb-in.	lb-ft
Trim cylinder hoses	11	100	

POWER TRIM

Section 5C - Dual Power Trim System

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5 C

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
Liquid Neoprene	All terminal connections	92-25711-3

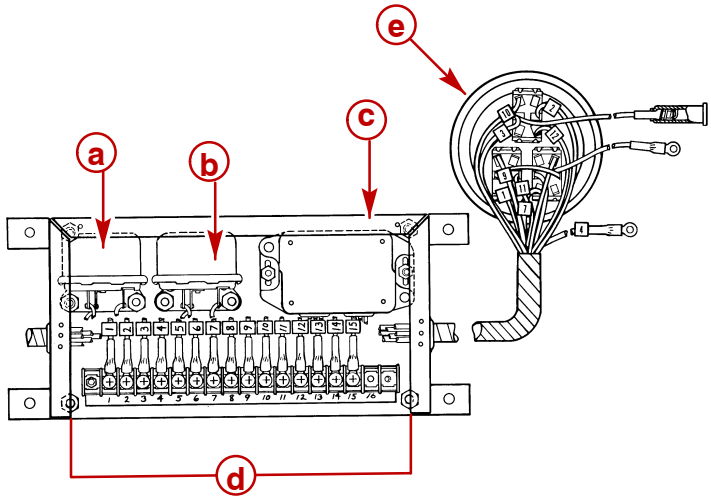
Important Information

When testing this Dual Power Trim system, take special note of the following:

- The control box harness connectors must be disconnected and the key switch must be OFF.
- Ensure that the jumper lead used between terminals 3 and 5 is used only when specified.

The following tests are listed in order of probable component failure. It is recommended, however, that all tests be performed even if a faulty component is detected early in the sequence. This precaution will guard against repeat failure if there is more than one failed component.

Testing Dual Power Trim System



22129

Dual trim control panel electrical box

a - Relay No. 1
b - Relay No. 2
c - Diode module
d - Terminal block
e - Control panel

Relay Test

Testing Relay No. 1

Step	Action	Yes	No
1.	Test for 12 volts at terminal 2, using only terminal 4 as a ground. **Is there a Voltage indicated?**	Proceed to 2.	Replace relay
2.	Connect a jumper wire between terminals 3 and 5. Test for 12 volts at terminal 2, using only terminal 4 as a ground. **Is there a Voltage indicated?**	Replace relay.	Relay OK

Testing Relay No. 2

Step	Action	Yes	No
1.	Test for continuity between terminals 13 and 9. **Is continuity indicated?**	Proceed to 2.	Replace relay
2.	Connect a jumper wire between terminals 3 and 5. Test for continuity between terminals 13 and 9. **Is continuity indicated?**	Replace relay.	Relay OK

Diode Module Test

Perform the following diode tests using an ohmmeter set on the Rx1 scale. When testing diodes, take 2 readings. Note the first reading; then, reverse the meter leads and, again, note the reading.If the diode is good, the meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading (below 60 ohms) when connected the other way. If both readings are high or infinite, the diode is open. Replace the diode module.

Diode No. 1

Step	Action	Yes	No
1.	Connect a jumper wire between terminals 3 and 5. Test the diode between terminals 9 and 10. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Diode No. 2

Step	Action	Yes	No
1.	Connect a jumper between terminals 3 and 5. Test diode between terminals 10 and 13. **Are both readings high or infinite?**	Replace the diode module.	Module OK

⚠ CAUTION
Before proceeding with further diode testing, remove fuse from red/purple harness lead so that it will not be possible to short either control box or VOA meter.

Diode No. 3

Step	Action	Yes	No
1.	Test the diode between terminals 6 and 12. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Diode No. 4

Step	Action	Yes	No
1.	Test the diode between terminals 12 and 7. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Diode No. 5

Step	Action	Yes	No
1.	Test the diode between terminals 8 and 11. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Diode No. 6

Step	Action	Yes	No
1.	Test the diode between terminals 14 and 15. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Diode No. 7

Step	Action	Yes	No
1.	Test the diode between terminals 8 and 5. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Diode No. 8

Step	Action	Yes	No
1.	Test the diode between terminals 5 and 15. **Are both readings high or infinite?**	Replace the diode module.	Module OK

Trailer Switch Test

⚠ CAUTION
Remove fuse from RED/PURPLE harness lead before proceeding with test.

Step	Action	Yes	No
1.	Set the ohmmeter on the Rx1 scale. Push down on the “Trailer” switch and check for continuity between terminals 10 and 3. **Is continuity indicated?**	Proceed to 2.	Replace the switch.
2.	Push up on the trailer switch and check for continuity between terminals 2 and 12. **Is continuity indicated?**	Switch OK	Replace the switch.

Starboard Trim Switch Test

Step	Action	Yes	No
1.	Set ohmmeter on Rx1 scale. Push down on STARBOARD TRIM switch and check for continuity between terminals 1 and 9. **Is continuity indicated?**	Proceed to 2.	Replace the switch.
2.	Push up on STARBOARD TRIM switch and check for continuity between terminals 11 and 6. **Is continuity indicated?**	Switch OK	Replace the switch.

Port Trim Switch Test

Step	Action	Yes	No
1.	Set ohmmeter on Rx1 scale. Push down on PORT TRIM switch and check for continuity between terminals 2 and 13. **Is continuity indicated?**	Proceed to 2.	Replace the switch.
2.	Push up on PORT TRIM switch and check for continuity between terminals 14 and 7. **Is continuity indicated?**	Switch OK	Replace the switch.

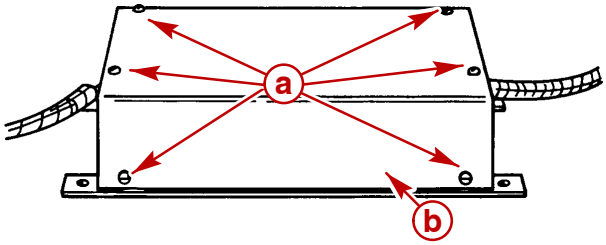
Dual Power Trim System Component Repair

Use care when removing and installing components. Do not force or pull wiring during replacement. Use care to prevent wiring from stretching, pinching, or chafing. Coat all terminals with lubricant.

Description	Where Used	Part Number
Liquid Neoprene	All terminal connections	92-25711-3

Relay Removal

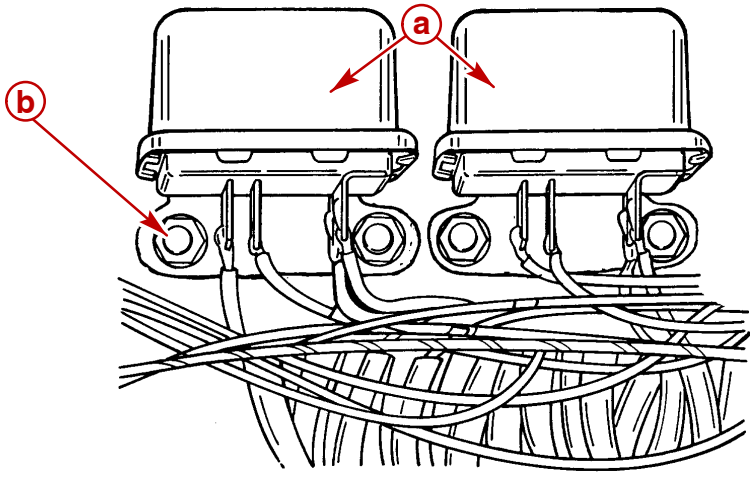
1. Remove control box cover.



22086

a - Screws
b - Cover

2. Unsolder wires from relay to be replaced.
3. Remove relay.



22086

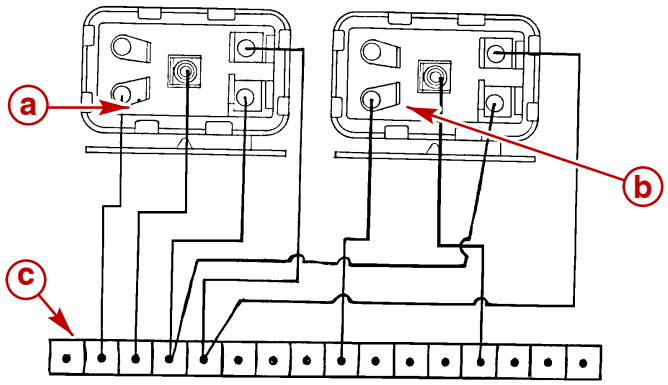
a - Relay assemblies (1 and 2)
b - Fasteners

Relay Installation

1. Install new relay.

IMPORTANT: Use 63/67 (Tin/Lead) alloy solder. Do not use acid core solder as damage to relay can result. Coat terminal connections with Liquid Neoprene.

2. Using 63/67 (Tin/Lead) alloy solder, solder wires from terminal block to relay as shown.
3. Coat terminal connections with lubricant.

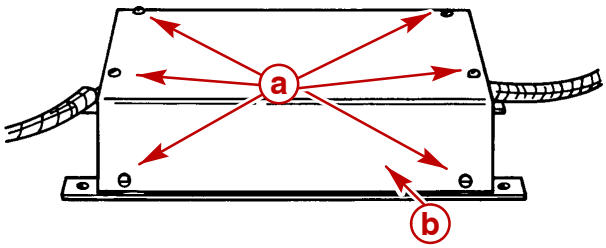


22216

a - Relay number 1
b - Relay number 2
c - Terminal block

Description	Where Used	Part Number
Liquid Neoprene	All terminal connections	92-25711-3

4. Install control box cover.
5. Tighten screws securely.

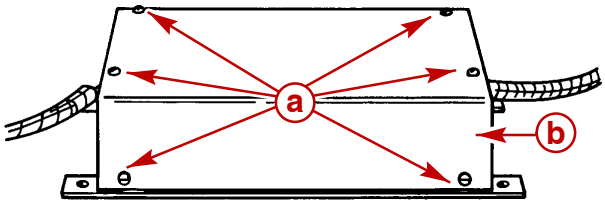


22086

a - Screws
b - Cover

Diode Module Removal

1. Remove control box cover.



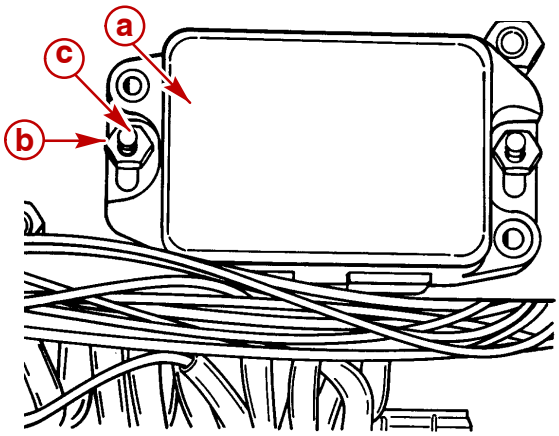
22086

a - Screws
b - Cover

2. Disconnect leads from terminal block.

Diode Module Installation

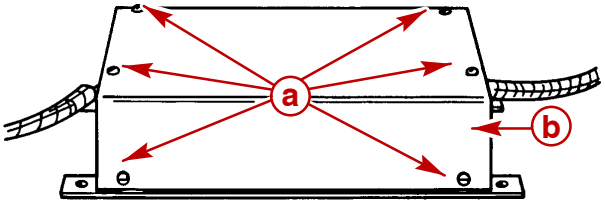
1. Replace diode module.



22086

a - Diode module
b - Nut
c - Bolt

2. Reconnect numbered leads to respective terminals.
3. Install control box cover.
4. Tighten screws securely.

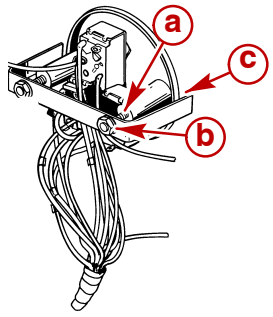


22086

a - Screws
b - Cover

Trim Control Panel Switch Removal

1. Remove trim control panel from dash.
2. Cut leads from switch to be replaced as close to switch terminals as possible.



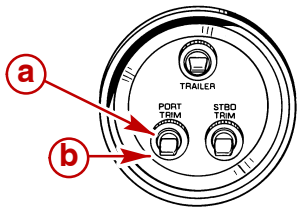
22086

a - Number 10-24 studs
b - Flat washers and nuts
c - U-bracket

3. Remove bezel nut.

Trim Control Panel Switch Installation

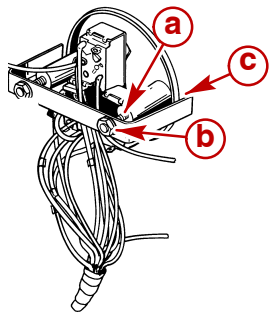
1. Replace switch.



22086

a - Bezel nut
b - Switch

2. With new switch properly positioned in control panel, loop leads through their respective terminal eyelets. Refer to Wiring Diagram.
3. Using 60/40 (Tin/Lead) alloy rosin core solder, solder leads to terminals.
4. Secure trim control panel to dash.

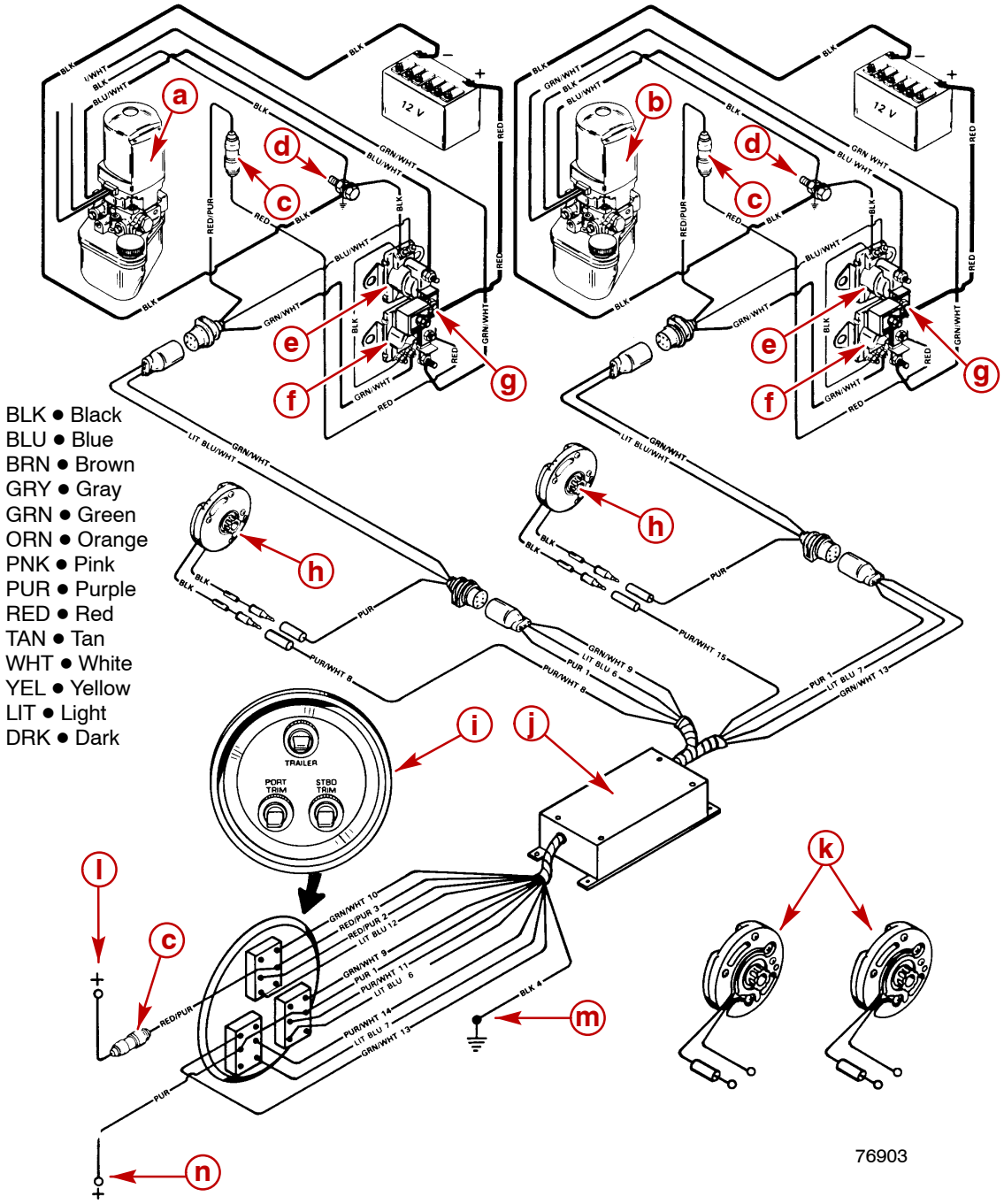


22086

a - Number 10-24 studs
b - Flat washers and nuts
c - U-bracket

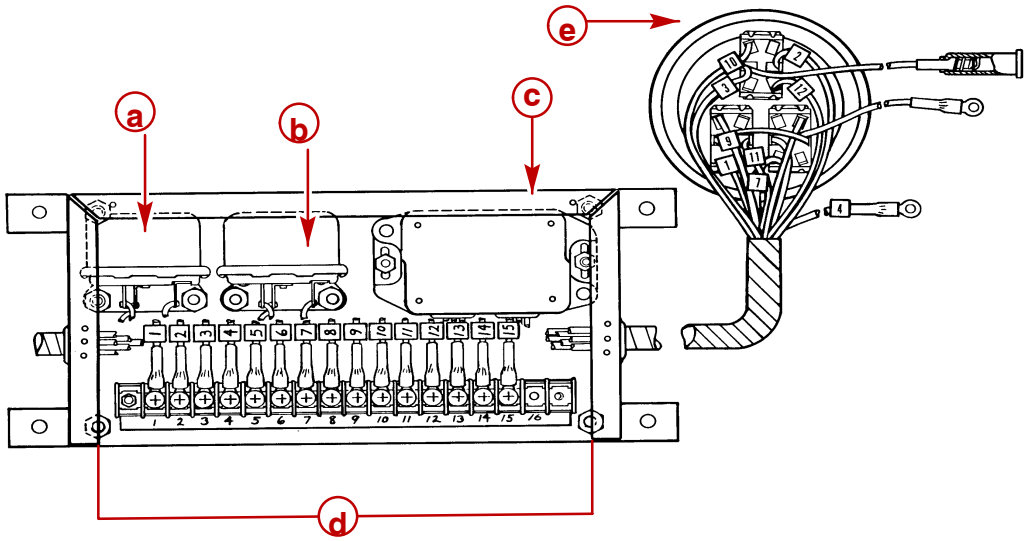
Wiring Diagrams

Dual Trim



a - Starboard trim pump
b - Port trim pump
c - 20 amp fuse
d - Ground bolt (floor mount)
e - UP solenoid
f - DOWN solenoid
g - 110 amp fuse
h - Trim limit switch
i - Trim switch (various styles)
j - Control module
k - Trim position sender
l - 12 Volt power from battery
m - Ground wire
n - 12 Volt power from switched side of ignition switch

Dual Trim Harness Control Module



22129

Dual trim control panel electrical box

- **a** - Relay No. 1
- **b** - Relay No. 2
- **c** - Diode module
- **d** - Terminal block
- **e** - Control panel

NOTES:

STEERING SYSTEMS

Section 6A - Power Steering

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6 A

Parts List

Description	Qty.	Part Number
Power Steering Pump Seal Kit[1]	1	5688044

[1] *Obtain from a local GM automotive dealer.*

Torque Specifications

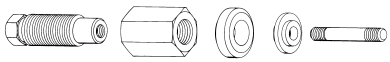
NOTE: *Securely tighten all fasteners not listed below.*

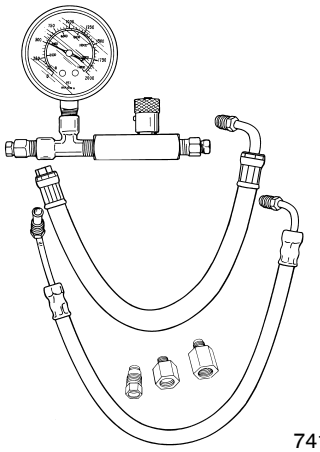
Description	Nm	lb-in.	lb-ft
Steering cable coupler nut	48		35
Steering system pivot bolts	34		25
Power steering hydraulic hose fittings	31		23
Power steering pump housing studs	47		35
Pump flow control valve fitting	47		35
Tie bar locknut	68		60
Fitting assembly	47		35
Power steering pump bolt and nut	41		30

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
Special Lubricant 101	Clevis pins, steering cable end	92-802865A1
	Bushings	
Power Trim and Steering Fluid	O-ring	92-802880A1
	End plate O-ring	
	Reservoir O-rings	
Loctite 277	Tie bar threads	Obtain locally
Power Trim and Steering Fluid	Power Trim Pump	92-802880A1
Dexron III Automatic Transmission Fluid		Obtain locally

Special Tools

Pulley Pusher Installer		
 73670	Installs the pulley on the power steering pump.	91-93656A1

Power Steering Test Gauge Kit		
 74167	Tests the power steering system pressure.	91-38053A4

Kent-Moore Tools

Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 774-9500	
Description	**Part Number**
Power Steering Pump Pulley Remover	J-25034

Description

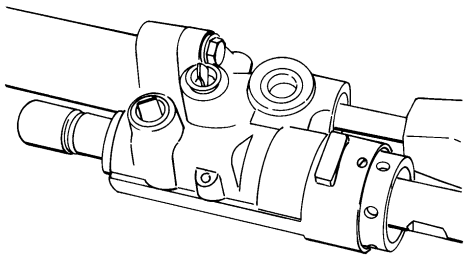
NOTE: *The power steering pump and related components covered in this section do not pertain to Mercury MerCruiser 8.1 liter (496 cid) gasoline engine models or any Mercury MerCruiser or Cummins MerCruiser diesel engine models. For information on these models refer to the appropriate engine service manual.*

The Power Steering system utilizes an engine-driven, vane-type hydraulic pump that supplies fluid flow and pressure by means of hoses to a control valve that, in turn, controls fluid flow and pressure to and from a booster cylinder. Modes make up the basic function of the Power Steering system: 1) neutral mode, 2) left turn mode, and 3) right turn mode. The control valve, which is activated by the steering cable, controls the steering system modes.

NOTE: *The following Power Steering unit installations are viewed from inside boat, looking at transom.*

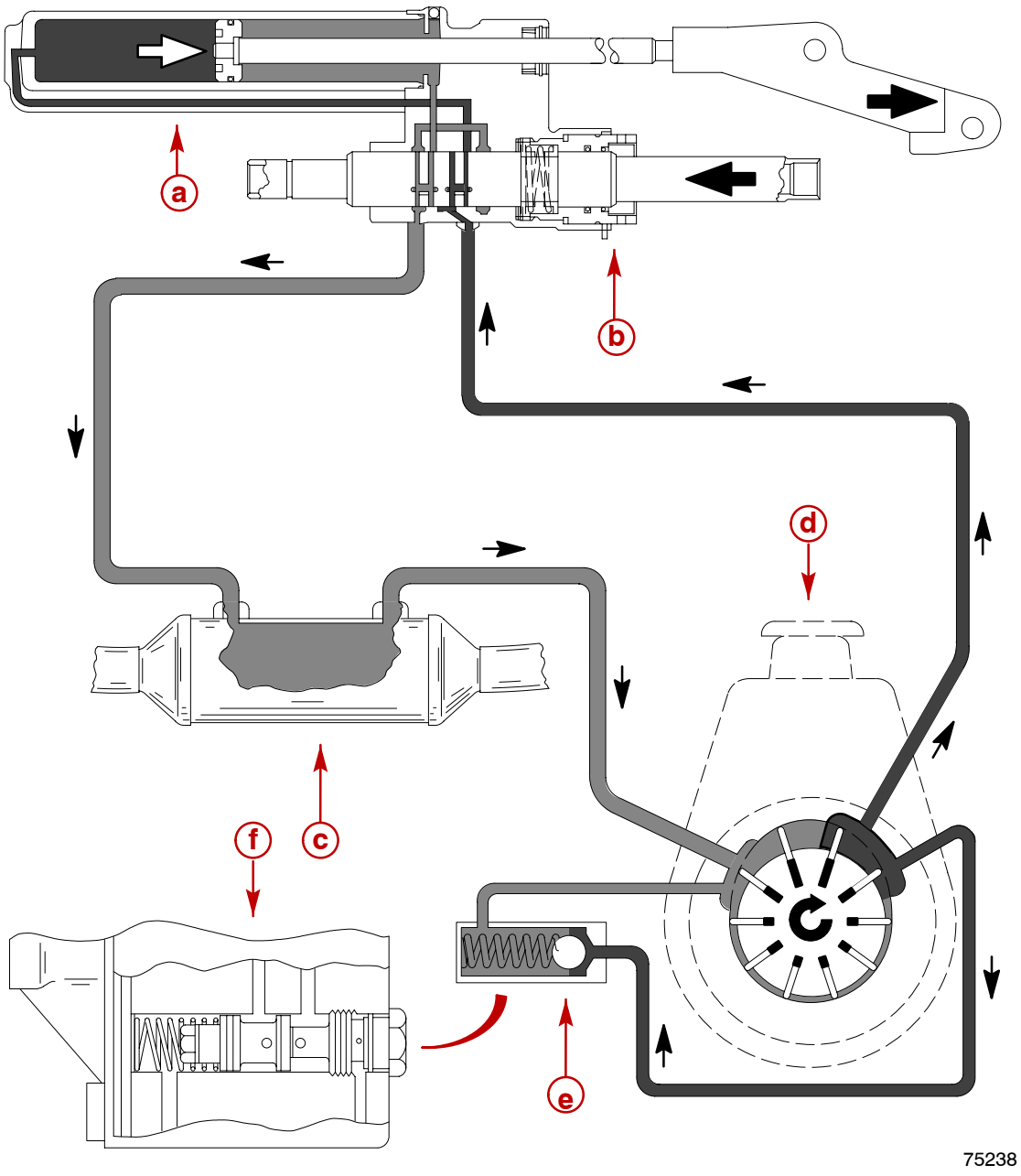
Control Valve

The control valve is not serviceable and must be replaced as a complete assembly.



73898

Power Steering System

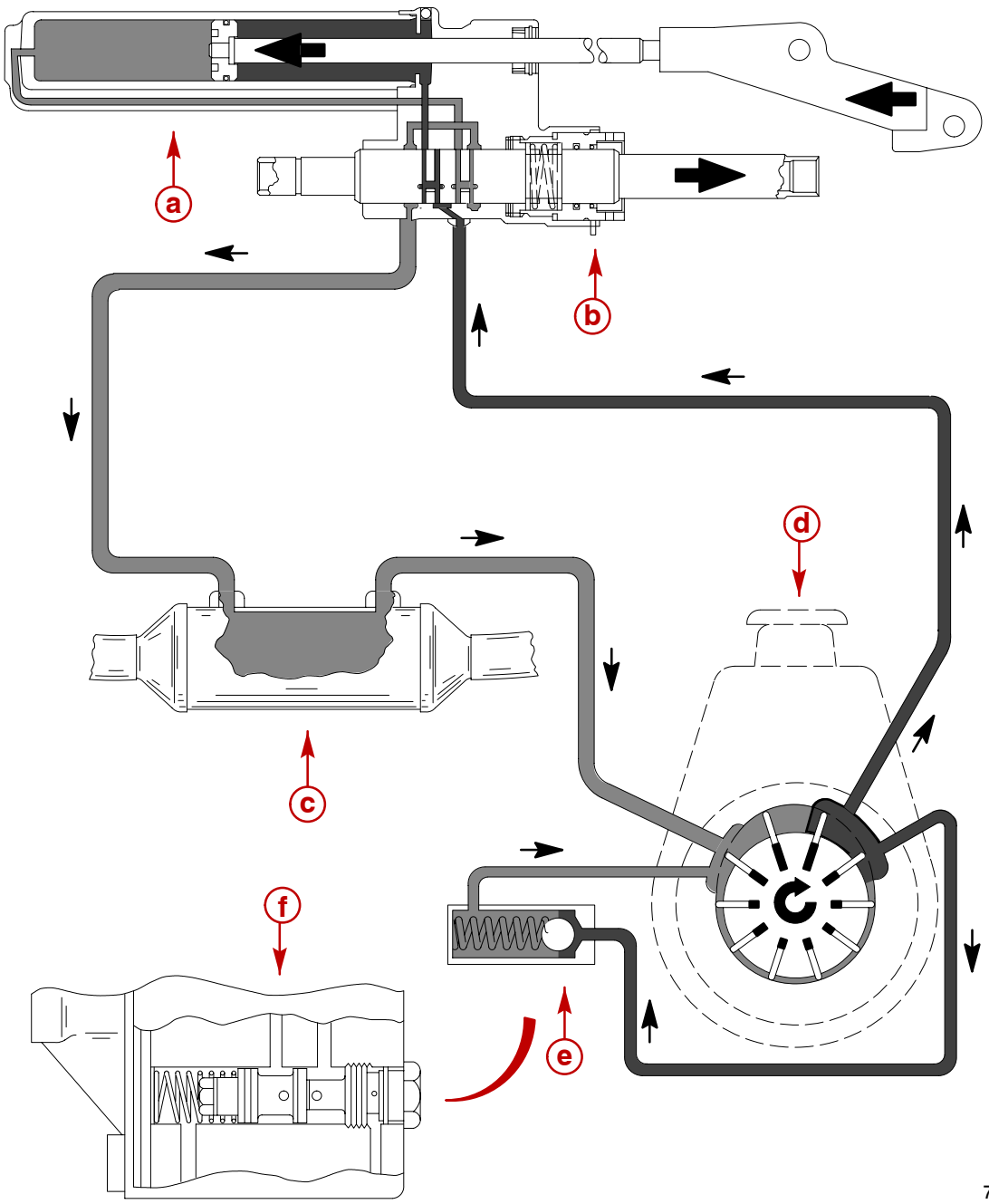


Right turn (Viewing from inside of boat looking at transom)

- **a** - Piston
- **b** - Control valve
- **c** - Oil cooler
- **d** - Pump
- **e** - Relief valve
- **f** - Pump housing

Description	High pressure	Low pressure
Internal System Pressure	7929-8618 kPa (1150-1250 psi)	483-862 kPa (70-125 psi)

Power Steering System

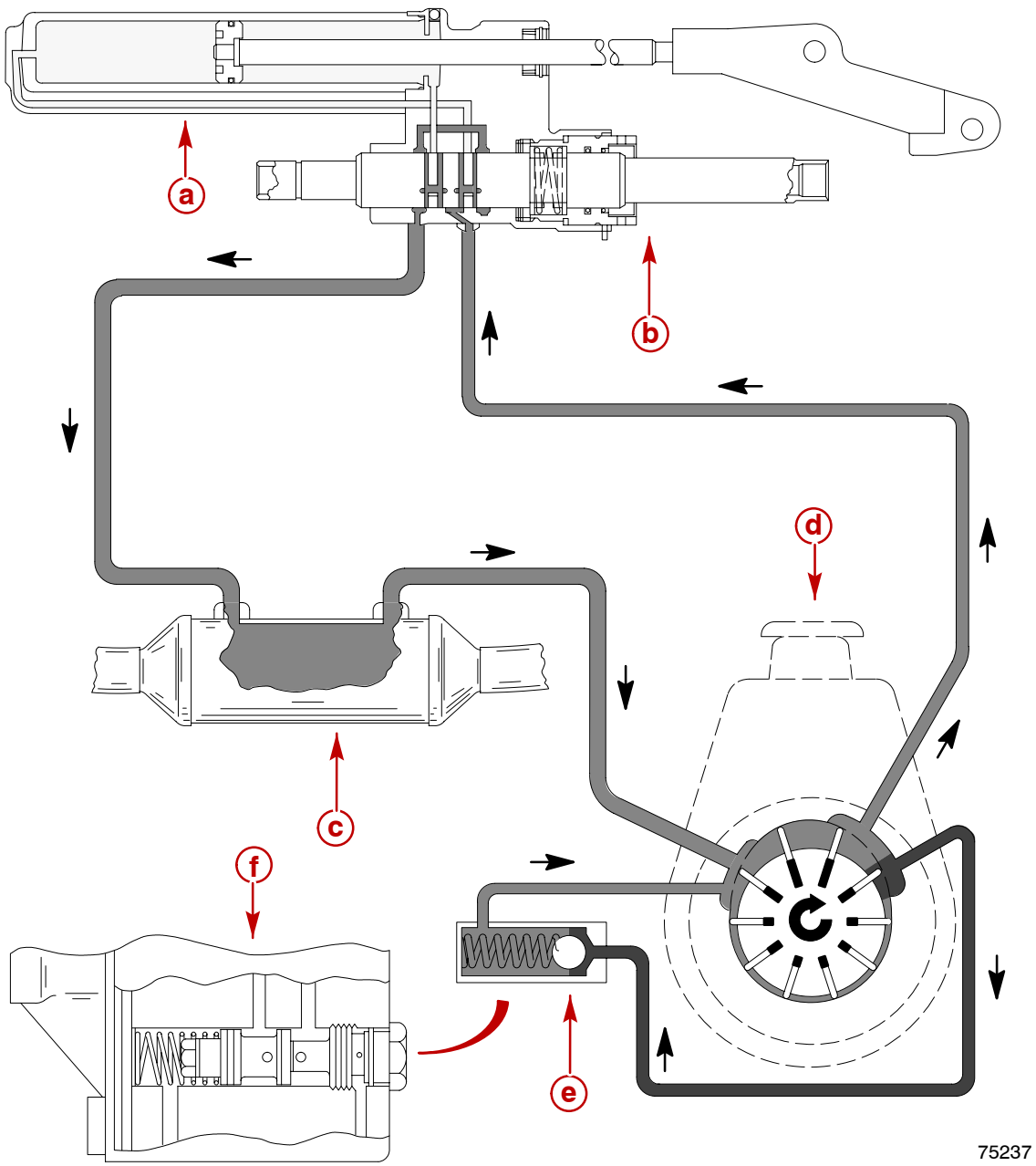


Left turn (Viewing from inside of boat looking at transom)

- **a** - Piston
- **b** - Control valve
- **c** - Oil cooler
- **d** - Pump
- **e** - Relief valve
- **f** - Pump housing

Description	High pressure	Low pressure
Internal System Pressure	7929-8618 kPa (1150-1250 psi)	483-862 kPa (70-125 psi)

Power Steering System



Neutral (Viewing from inside of boat looking at transom)

- **a** - Piston
- **b** - Control valve
- **c** - Oil cooler
- **d** - Pump
- **e** - Relief valve
- **f** - Pump housing

Description	High pressure	Low pressure
Internal system pressure	7929-8618 kPa (1150-1250 psi)	483-862 kPa (70-125 psi)

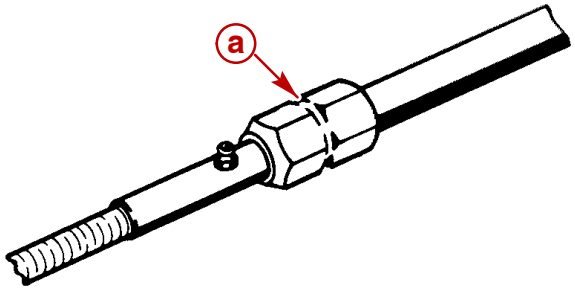
Steering Helm and Cable

The transom assembly is shipped with the steering cable guide tube preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

WARNING

Failure to use a steering cable locking device could cause loss of steering, which could cause damage to the boat and/or injury.

NOTE: *All current production Quicksilver RideGuide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)*



22060

a - Quicksilver RideGuide steering cable self-locking coupler nut (identified by groove)

IMPORTANT: If using a steering cable that does not have a self-locking coupler nut, an external locking device such as a locking sleeve must be used.

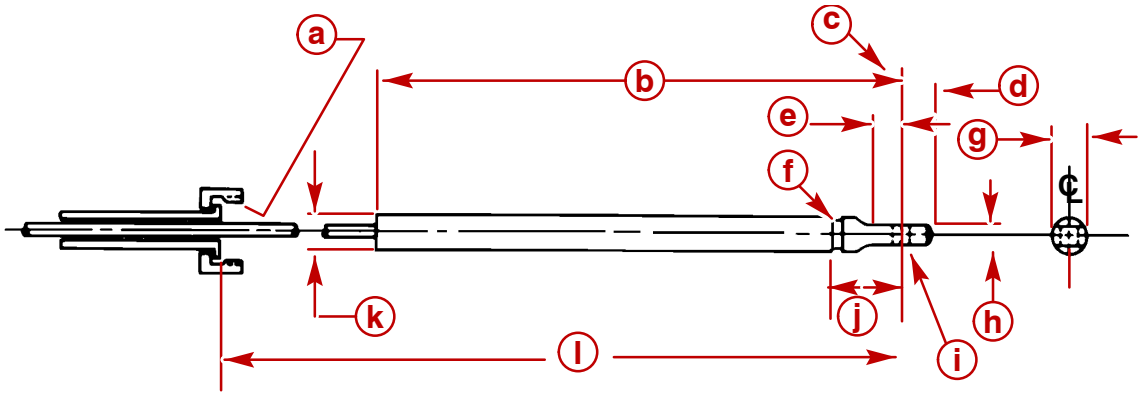
⚠ CAUTION

If steering cable with improper dimensions is installed, severe damage to transom assembly and/or steering system may result.

1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks, or loops in cable.
3. Fully extended steering cable end dimension must be as shown.

STEERING CABLE SPECIFICATIONS

IMPORTANT: Power steering pump lugging (squealing) in a hard right turn (against lock) may mean a steering cable has been installed that does not have the correct dimensions.



21435

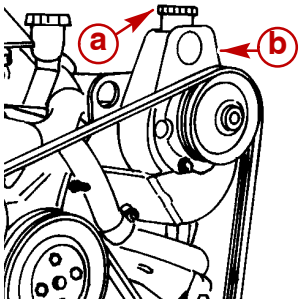
a - Coupler nut - 7/8 - 14 UNF - 2B thread
b - 298 mm (11-3/4 in.) minimum
c - Interface point
d - 12.7 mm (1/2 in.) maximum
e - 10.7 mm (27/64 in.) minimum flat
f - 3.1 mm (7/64 in.) minimum radius
g - 15.9 mm (5/8 in.) maximum diameter end fitting
h - 9.5 mm (3/8 in.)
i - 9.8 mm (3/8 in.) diameter through hole, chamfered each side
j - 34.9 mm (1-3/8 in.) maximum
k - 15.9 mm (5/8 in.) diameter tube
l - Cable travel:
-Mid-travel position - 428.6 mm (16-7/8 in.)
-Total travel to be 203.2 mm (8 in.) minimum, to 228.6 mm (9 in.) maximum
-Travel each side of mid-travel position -101.6 mm (4 in.) minimum, 114.3 mm (4-1/2 in.) maximum

Filling and Air Bleeding Power Steering System

Checking Fluid Level

ENGINE WARM

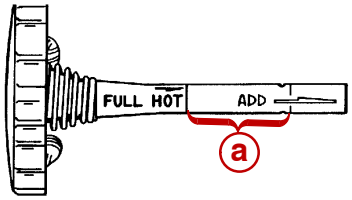
1. Stop engine. Position sterndrive unit so that it is straight back.
2. Remove fill cap / dipstick from power steering pump and note fluid level.



74908

a - Fill cap / dipstick
b - Power steering pump

3. Level should be between the FULL HOT mark and ADD mark on dipstick.



72518

a - Proper fluid level with engine warm

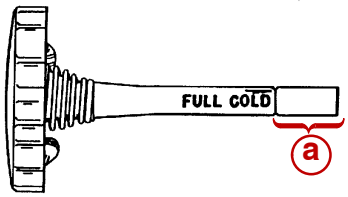
4. If level is below ADD mark, but fluid is still visible in pump reservoir, add required amount of fluid through fill cap opening, to bring level up to FULL HOT mark on dipstick. DO NOT OVERFILL.

Description	Where Used	Part Number
Power Trim and Steering Fluid	Power Trim Pump	92-802880A1
Dexron III Automatic Transmission Fluid		Obtain locally

5. If fluid is not visible in reservoir, a leak exists in the power steering system. Find cause and correct.

ENGINE COLD

1. With engine stopped, position sterndrive unit so that it is straight back.
2. Remove fill cap / dipstick from power steering pump and note fluid level.
3. Level should be between FULL COLD mark and bottom of dipstick.



72519

a - Proper fluid level with engine cold

4. If level is below bottom of dipstick, but fluid is still visible in pump reservoir, add required amount of fluid, through fill cap opening, to bring level up to FULL COLD mark on dipstick. DO NOT OVERFILL.

Description	Where Used	Part Number
Power Trim and Steering Fluid	Power Trim Pump	92-802880A1
Dexron III Automatic Transmission Fluid		Obtain locally

If fluid is not visible in reservoir, a leak exists in the power steering system. Find cause and correct.

Filling and Bleeding

IMPORTANT: Power steering system must be filled exactly as explained in the following to ensure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause power steering system to become spongy, which may result in poor boat control.

1. With engine stopped, position sterndrive unit so that it is straight back.
2. Remove fill cap / dipstick from power steering pump.
3. Add approved fluid to bring level up to FULL COLD mark on dipstick.

IMPORTANT: Use only Power Trim and Steering Fluid or Dexron III automatic transmission fluid (ATF) in power steering system.

Description	Where Used	Part Number
Power Trim and Steering Fluid	Power Trim Pump	92-802880A1
Dexron III Automatic Transmission Fluid		Obtain locally

4. Turn steering wheel back and forth to end of travel in each direction several times.
5. Recheck fluid level and add fluid, if necessary.
6. Install vented fill cap. Tighten securely.

⚠ CAUTION

Do not operate engine without water being supplied to seawater pickup pump, or pump impeller may be damaged and subsequent overheating damage to engine may result.

7. Start engine and operate at fast idle (1000-1500 rpm) until engine reaches normal operating temperature. During this time, turn steering wheel back and forth to end of travel in each direction several times.
8. Position sterndrive unit so that it is straight back and stop engine.
9. Remove fill cap from pump.
10. Allow any foam in pump reservoir to disperse.
11. Check fluid level and add fluid, as required, to bring level up to FULL HOT mark on dipstick. Do not over fill.
12. Reinstall fill cap. Tighten securely.

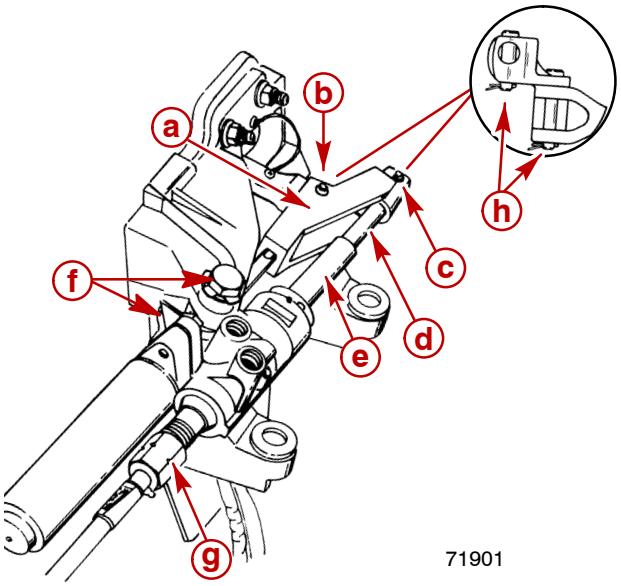
IMPORTANT: Sterndrive unit must be positioned straight back and power steering fluid must be hot to accurately check fluid level.

13. If fluid is still foamy (in Step 5.), repeat Steps 7. through 12. until fluid does not foam and level remains constant.

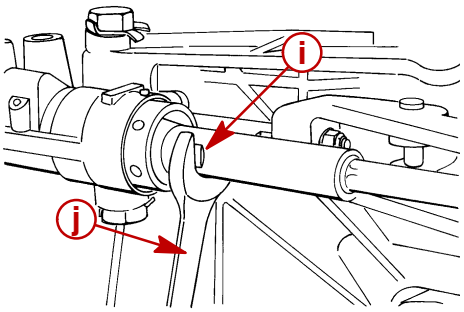
Power Steering Assembly

Removal

1. Remove rear clevis pin from steering lever.
2. Remove forward clevis pin from steering cable.
3. Using suitable wrenches, hold the flat surfaces on the cable guide tube in the vertical position then loosen the coupler nut and remove the steering cable.
4. Remove and plug the power steering hoses.
5. Straighten locking tabs on pivot bolt washers.
6. Remove the pivot bolts.
7. Remove the power steering unit from transom.



71901



73901

Control valve

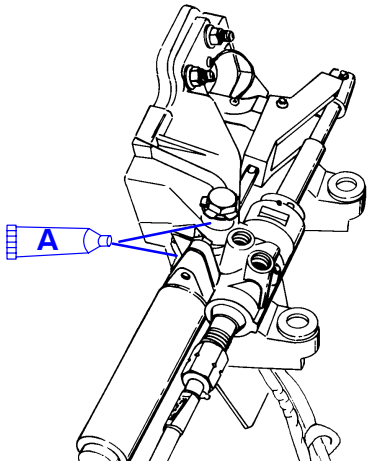
- **a** - Clevis
- **b** - Rear clevis pin
- **c** - Forward clevis pin
- **d** - Steering cable end
- **e** - Cable guide
- **f** - Pivot bolt
- **g** - Coupler nut
- **h** - Cotter pins
- **i** - Flat surface on tube
- **j** - Suitable wrench

Installation

⚠ WARNING

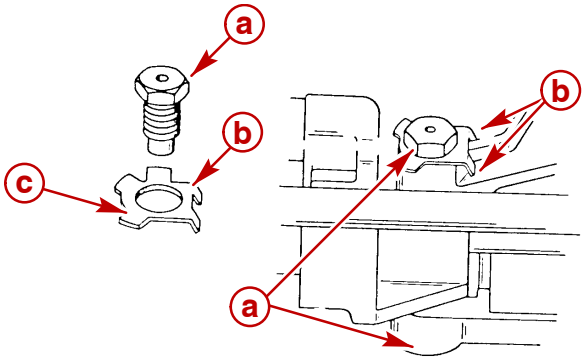
Steering cable outer casing must be free to move back-and-forth for steering to function properly. Do not fasten any wires, cables, or other items to steering cable, as this may prevent it from moving.

1. Lubricate bushings.



Description		Where Used	Part Number
A	Special Lubricant 101	Bushings	92-802865A1

2. Slide the power steering cylinder bushings between the transom mounting brackets. Tighten the 2 pivot bolts by hand. Move the steering assembly slightly to ensure proper pin engagement into the pivot bushings.
3. Ensure that the washer tangs straddle the ridges on the inner transom plate.



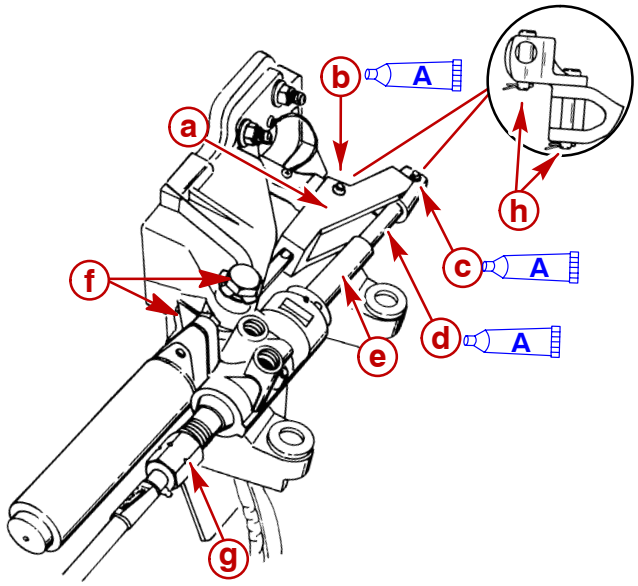
a - Pivot bolt
b - Washer tang
c - Washer tab

4. Torque the pivot bolts.

Description	Nm	lb-in.	lb-ft
Steering system pivot bolts	34		25

5. Bend the washer tabs against the corresponding flats on both pivot bolt heads.
6. Ensure the power steering control valve pivots freely.

7. Connect the power steering unit to the steering lever.
   a. Lubricate the clevis pins.
   b. Install the clevis pin in the clevis from the top.
   c. Secure the pin in the clevis with a cotter pin. Spread the cotter pin ends.
8. Lubricate the steering cable end and install the cable through the guide.
9. Start the coupler nut on the cable guide tube. Do not tighten at this time.
10. Connect the cable end to the clevis with the forward clevis pin. Spread the cotter pin ends.



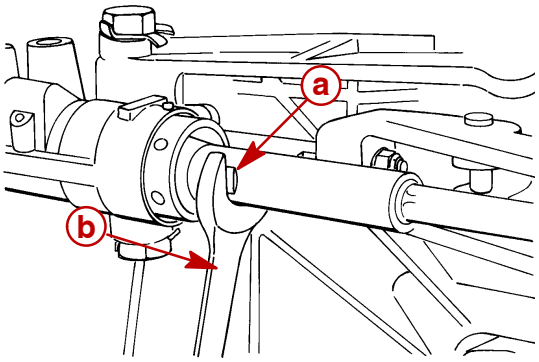
71901

Control valve

- **a** - Clevis
- **b** - Rear clevis pin
- **c** - Forward clevis pin
- **d** - Steering cable end
- **e** - Cable guide
- **f** - Pivot bolt
- **g** - Coupler nut
- **h** - Cotter pins

Description		Where Used	Part Number
A	Special Lubricant 101	Clevis pins, steering cable end	92-802865A1

11. Using a suitable wrench, hold the flat surfaces on the cable guide tube in the vertical position. Torque the coupler nut. **Be certain the flat surfaces are still aligned vertically after torque is applied to coupler nut.**



73901

a - Flat surface
b - Suitable wrench

Description	Nm	lb-in.	lb-ft
Steering cable coupler nut	47		35

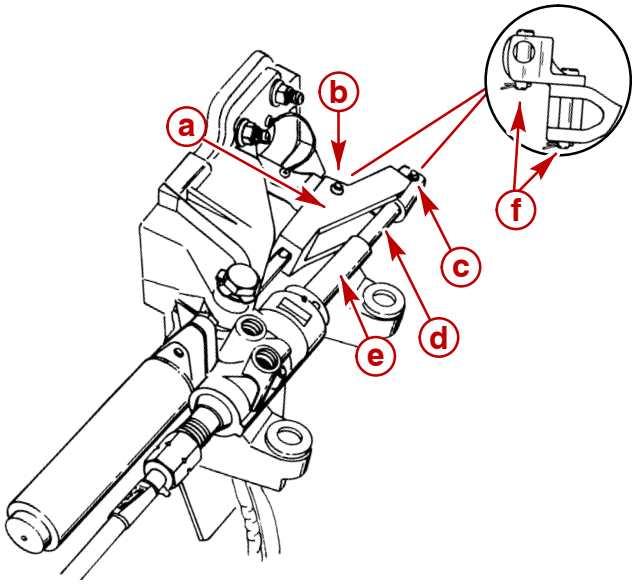
12. Install power steering hoses to power steering assembly.
    a. Torque both fittings. Route hoses as described in **Section 2A** to avoid contact with the steering system components.

Description	Nm	lb-in.	lb-ft
Power steering hydraulic hose fittings	31		23

Power Steering System Pressure

The following instructions are arranged so that a defective part can be detected by the process of elimination. It is suggested that the order of the instructions be followed so that the Power Steering System can be tested effectively.

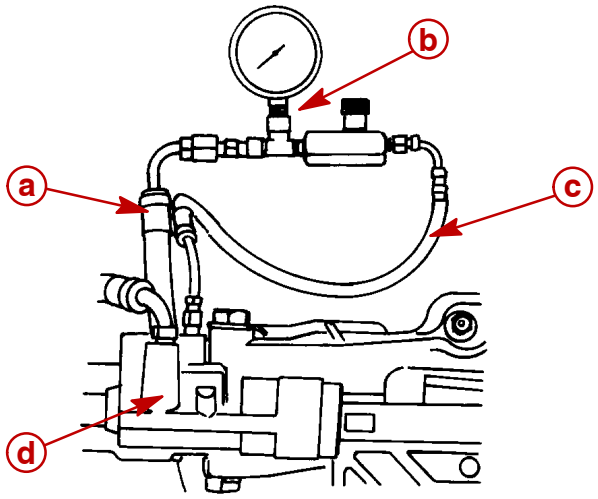
1. Remove front and rear clevis pins.
2. Retract cable into cable guide tube.



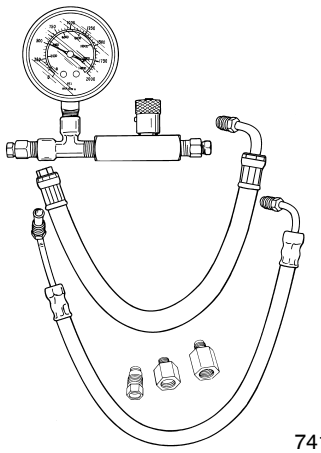
71901

a - Clevis
b - Rear clevis pin
c - Forward clevis pin
d - Steering cable end
e - Cable guide tube
f - Cotter pins

3. Assemble and install test gauge.



a - Pump pressure hose
b - Test gauge assembly
c - Gauge to control valve hose
d - Control valve

Power Steering Test Gauge Kit		
 74167	Tests the power steering system pressure.	91-38053A4

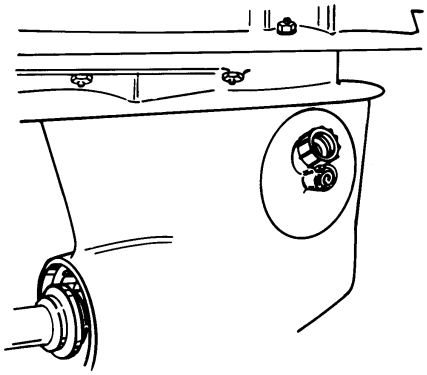
4. Open valve on gauge completely.

⚠ CAUTION

Do not operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

NOTE: *For complete instructions for attaching a flush test device to the various water inlets refer to* ***Sterndrive Water Pickups in Section 1B.***

5. Connect a flush test device to sterndrive unit. Partially open water tap (approximately 1/2 maximum) and allow cooling system to fill completely. Cooling system is full when water is discharged through the propeller. Do not use full water tap pressure.



22029

Standard Bravo shown

6. Start engine and operate at 1000-1500 rpm until engine reaches normal operating temperature.
7. With engine at idle speed, test gauge reading should be between 483 and 862 kPa (70 and 125 psi). If not, proceed as follows:

If lower than 483 kPa (70 psi), proceed to **Pump Pressure Test**.

If higher than 862 kPa (125 psi), check for hose restrictions in the system.

⚠ CAUTION

Do not lug pump at maximum pressure for more than 5 seconds in next step or damage to power steering pump may occur.

8. Push in then pull steering cable **momentarily**. Gauge reading should show an instant increase in pressure when block is pushed in both directions.
9. Push steering cable in until booster cylinder piston rod is fully retracted. With piston rod in this position, **momentarily** push steering cable in until maximum pressure reading is obtained.

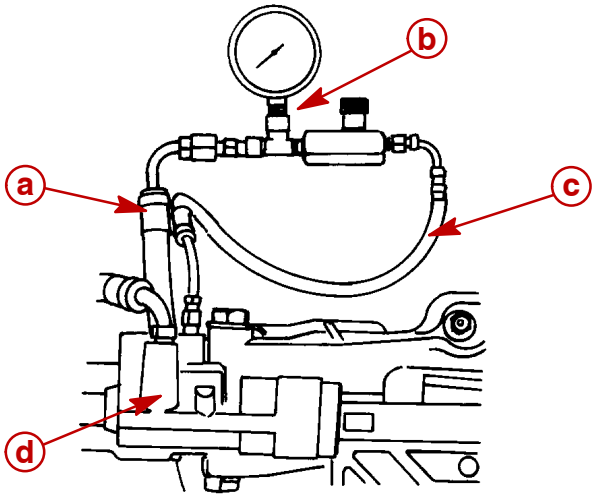
- **If pressure is above 6897 kPa (1000 psi),** system pressure is good.
- **If pressure is below 6897 kPa (1000 psi),** conduct **Pump Pressure Test**.

Pump Pressure Test

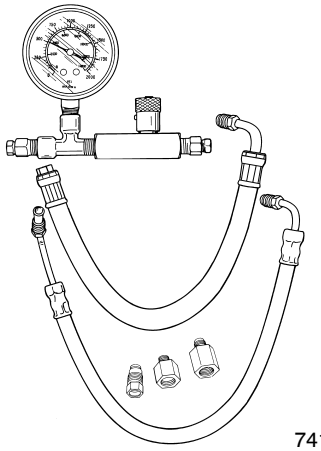
⚠ CAUTION

In performing the following test, do not lug pump at maximum pressure for more than 5 seconds or damage to power steering pump may occur.

1. Install test gauge.



a - Pump pressure hose
b - Test gauge assembly
c - Gauge to control valve hose
d - Control valve

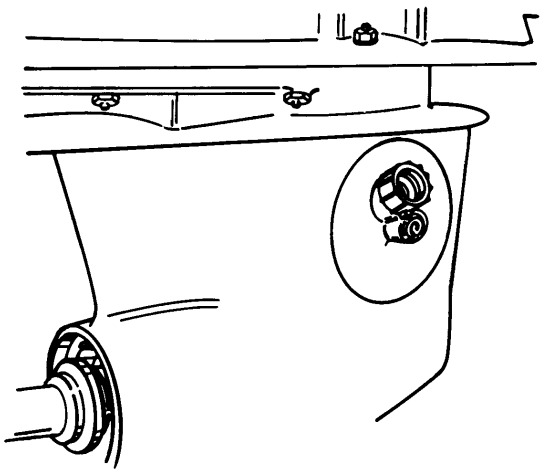
Power Steering Test Gauge Kit		
 74167	Tests the power steering system pressure.	91-38053A4

⚠ CAUTION

Do not operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

NOTE: *For complete instructions for attaching a flush test device to the various water inlets refer to* ***Sterndrive Water Pickups in Section 1B.***

2. Connect a flush test device to sterndrive unit. Partially open water tap (approximately 1/2 maximum) and allow water to enter cooling system. Do not use full water tap pressure.



22029

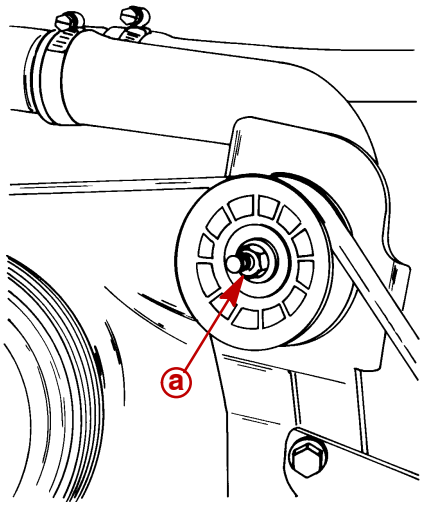
Standard Bravo shown

3. Start engine and operate at 1000-1500 rpm until engine reaches normal operating temperature.
4. Close test gauge valve just long enough to obtain maximum pressure reading.
5. Close and open valve 3 times. Record highest pressure reading attained each time.
   a. **If pressure readings are between 7932-8621 kPa (1150 and 1250 psi) and are within a range of 345 kPa (50 psi),** the pump is within specifications. If the **pump** tests OK, but system pressure was low (as tested under **Power Steering System Pressure Test**), proceed to **Booster Cylinder Test**.
   b. **If pressure readings are between 7932-8621 kPa (1150-1250 psi), but are not within a 345 kPa (50 psi) range,** the power steering pump flow control valve is sticking or pump hydraulic system is dirty.
   c. **If pressure readings are constant, but below 6897 kPa (1000 psi),** replace power steering pump.

Power Steering Pump

Removal

1. Loosen the adjusting stud and remove the serpentine belt from the power steering pulley.

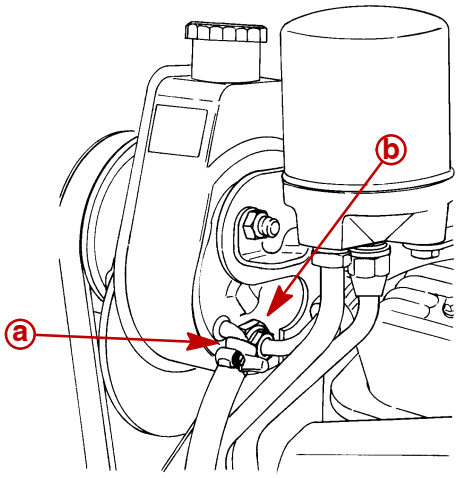


75483

a - Adjusting nut

NOTE: *Use a suitable container to catch power steering fluid when removing the power steering hoses.*

2. Remove the high pressure hose and return hose from the power steering pump.

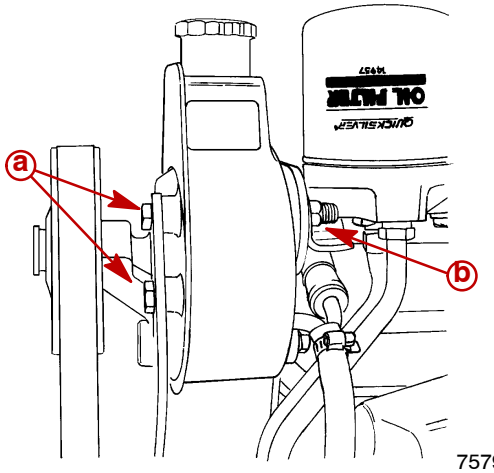


75228

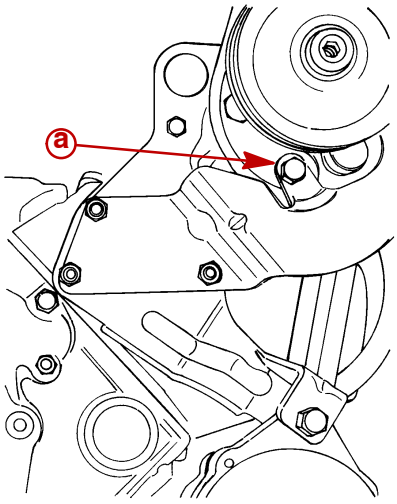
Power steering pump typical location

a - Return hose
b - High pressure hose

3. Remove mounting fasteners from pump.



75798



75228

Power steering pump typical location

a - Nut
b - Bolts

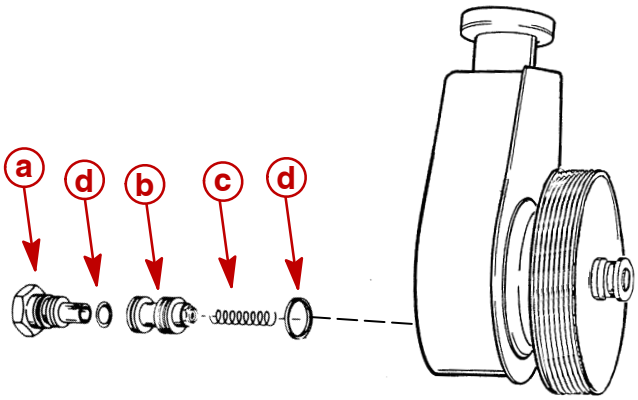
4. Remove the power steering pump from the bracket.

Flow Control Valve Servicing

⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

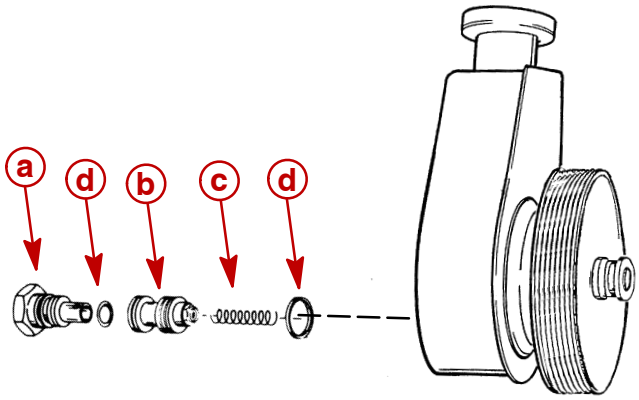
1. Drain fluid from pump.
2. Remove components shown.



76869

a - Fitting assembly
b - Control valve assembly
c - Flow control spring
d - O-rings

3. Inspect control valve assembly and fitting assembly for contamination and damage.
4. Install components shown and torque fitting.



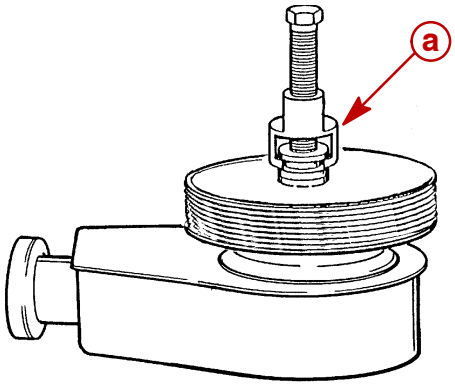
76869

a - Fitting assembly
b - Control valve assembly
c - Flow control spring
d - New O-rings

Description	Nm	lb-in.	lb-ft
Pump flow control valve fitting	47		35

Pump Shaft Oil Seal Replacement

1. Remove pump pulley.

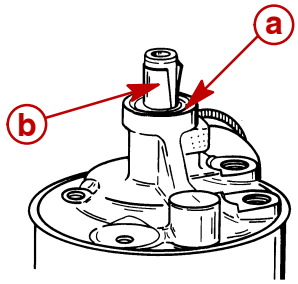


76895

a - Pulley removal tool

Description	Part Number
Pulley Removal Tool	J-25034

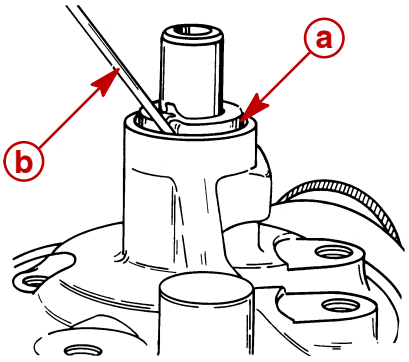
2. Push a 0.13 mm (0.005 in.) shim stock past the oil seal until it contacts the pump body (approximately 64 mm [2-1/2 in.] long).



76830

a - Oil seal
b - Shim stock

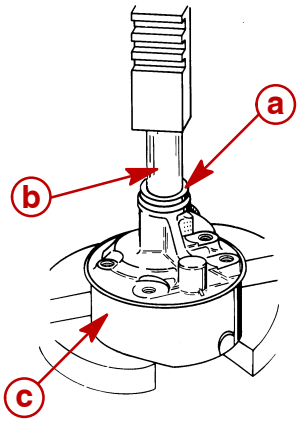
3. Remove oil seal.
4. Remove shim stock.



22152

a - Seal
b - Suitable tool

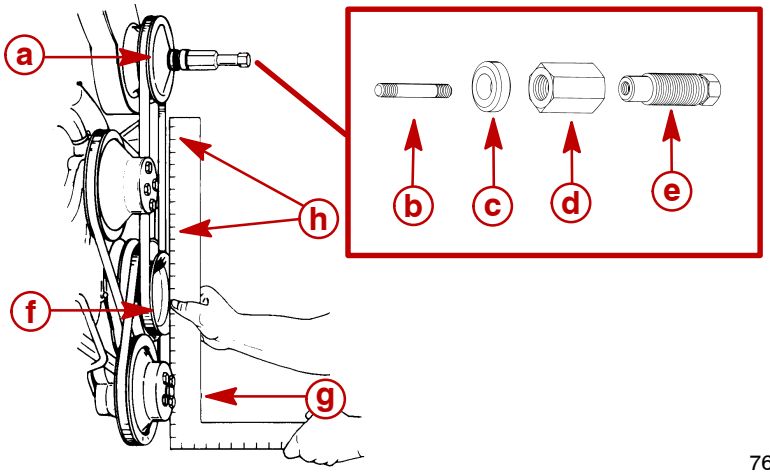
5. Install new oil seal. Properly support pump reservoir so that reservoir back does not distort.



22151

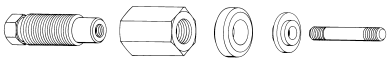
a - New oil seal - metal side up
b - Suitable mandrel
c - Pump reservoir

6. Install pulley using Pulley Pusher Installer and a long straight edge:
   a. Place pulley on pump shaft.
   b. Thread stud all the way into pump shaft.
   c. Place bearing over stud.
   d. Do not use spacer from kit.
   e. Thread nut onto shaft. Thread shaft and nut all the way onto stud.
   f. Using a long straight edge to check drive belt alignment, turn large pusher nut until drive belt is parallel to straight edge.
   g. Check pulley installation for correct alignment.



76896

a - Power steering pump pulley
b - Stud
c - Bearing
d - Nut
e - Shaft
f - Crankshaft pulley (shown) or water circulating pump pulley
g - Long straight edge
h - Drive belt parallel

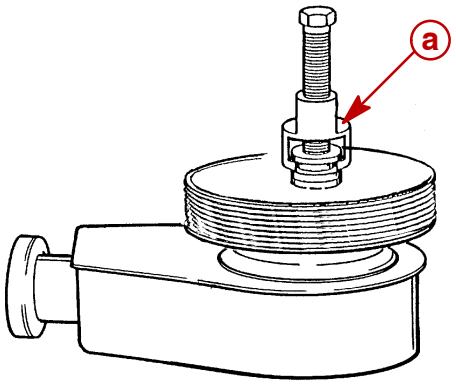
Pulley Pusher Installer		
 73670	Installs the pulley on the power steering pump.	91-93656A1

Disassembly

⚠ CAUTION

ENVIRONMENTAL HAZARD! Discharge of oil or oil waste into the environment is restricted by law. Do not spill oil or oil waste into the environment when using or servicing your boat. Contain and dispose of oil or oil waste as defined by local authorities.

1. Drain fluid from pump.
2. Remove pump pulley.

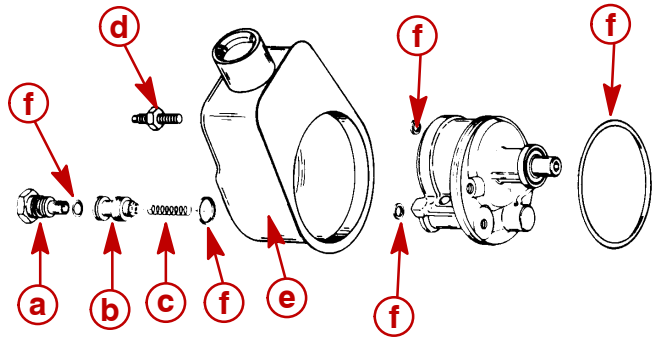


72821

a - Pulley Remover

Description	Part Number
Power Steering Pump Pulley Remover	J-25034

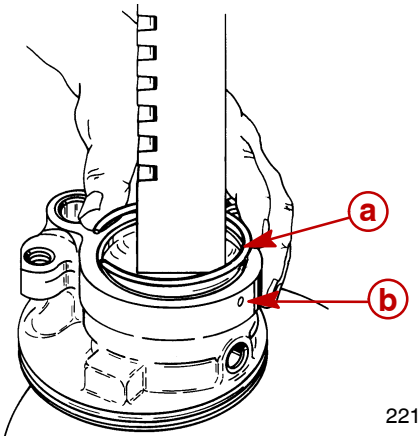
3. Remove reservoir, fitting assembly, control valve assembly, flow control spring, studs, and O-rings.
4. Discard O-rings and retain the other parts.



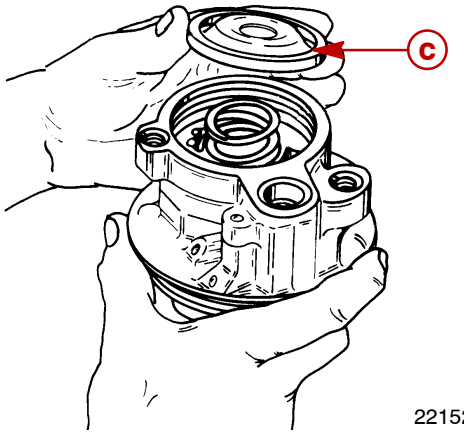
22155

a - Fitting assembly
b - Control valve assembly
c - Flow control spring
d - Studs
e - Reservoir
f - O-rings

5. Position retaining ring so that ring end is 25 mm (1 in.) from end of hole in housing.
6. Support housing in press and push down on end plate to remove tension on retaining ring.
7. Insert awl into hole in housing to push ring from recess.
8. Use screwdriver to remove retaining ring and end plate.



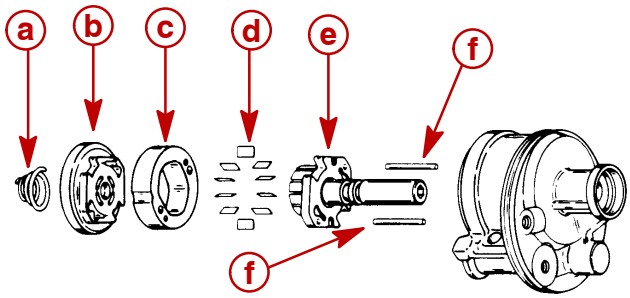
22151



22152

a - Retaining ring
b - Hole
c - End plate

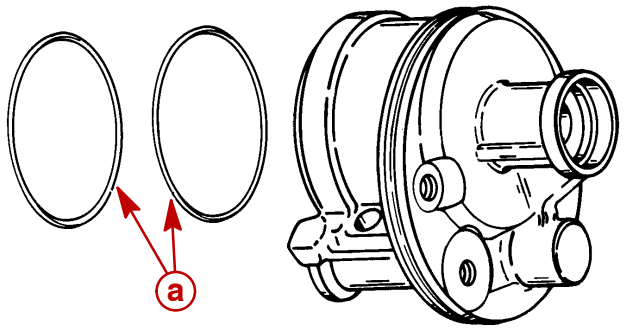
9. Remove pump components shown.



22155

a - Spring
b - Pressure plate
c - Pump ring
d - Pump vanes
e - Pump shaft and rotor assembly
f - Dowel pins

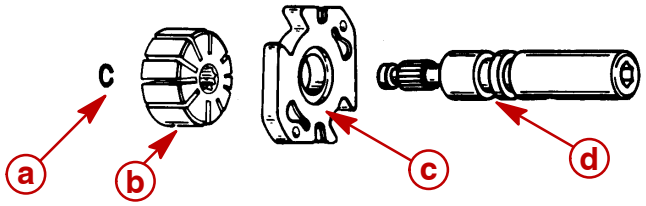
10. Remove and discard O-rings from housing.



22155

a - O-rings

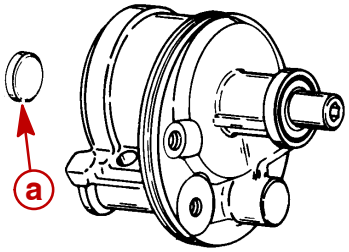
11. Remove retaining ring, rotor, and thrust plate.



22155

a - Retaining ring
b - Rotor
c - Thrust plate
d - Pump shaft

12. Remove magnet.



22154

a - Magnet

Cleaning And Inspection

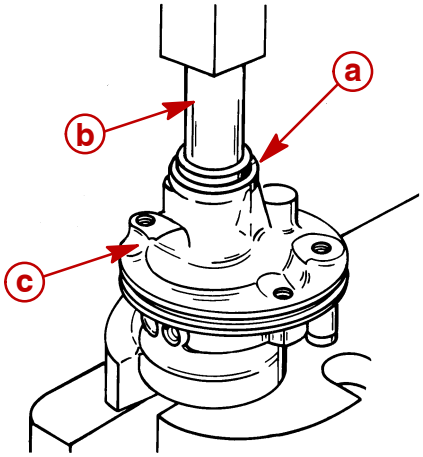
1. Clean and inspect all metal parts.

Reassembly

NOTE: *All references to Power Steering fluid refer to Power Trim and Steering Fluid or Dexron II if Quicksilver product is not available.*

NOTE: *Obtain and install a new seal kit 5688044 from a local GM automotive dealer when reassembling pump.*

1. Install new pump shaft oil seal metal side up. Support the pump reservoir so that the back does not distort.



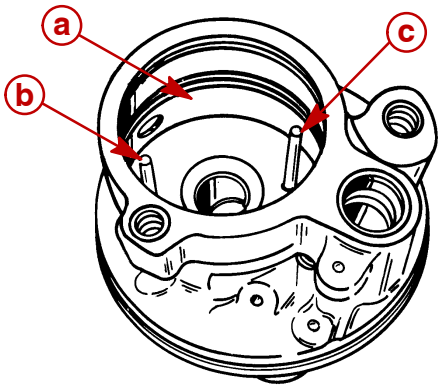
22151

a - New oil seal
b - 1 in. socket
c - Pump reservoir

2. Lubricate pressure plate O-ring and place in the third groove in the housing.

Description	Where Used	Part Number
Power Trim and Steering Fluid	O-ring	92-802880A1

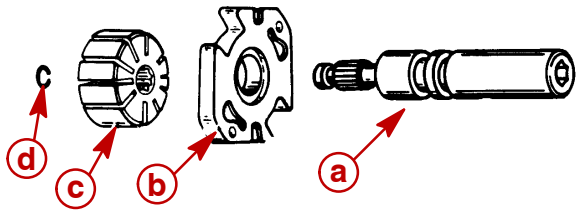
3. Install dowel pins.



22150

a - Pressure plate O-ring
b - Dowel pins

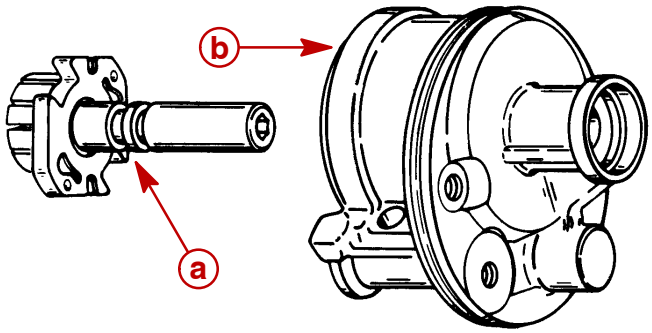
4. Assemble pump shaft and rotor assembly. Rotor should be installed with the countersunk side toward the thrust plate.



22155

a - Pump shaft
b - Thrust plate
c - Rotor
d - Retaining ring

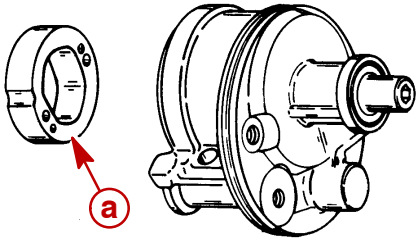
5. Install pump shaft and rotor assembly.



22154

a - Pump shaft and rotor assembly
b - Pump housing

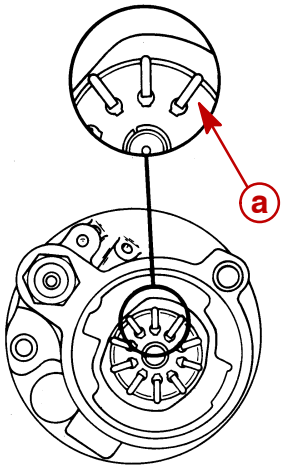
6. Install pump ring by placing the 2 smaller holes over the dowel pins.



22154

a - Pump ring

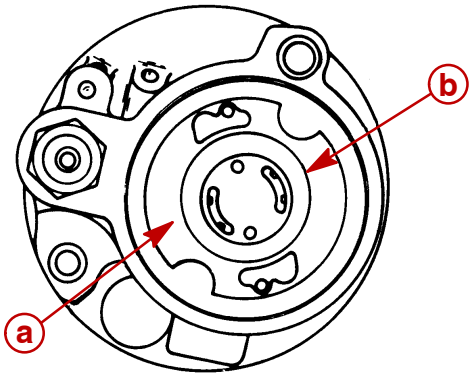
7. Install vanes in rotor slots with rounded edges toward pump ring. Vanes must slide freely.



22154

a - Vanes

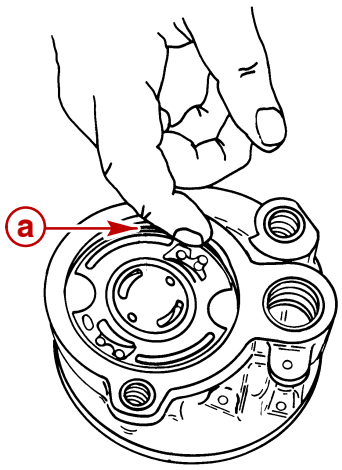
8. Install pressure plate. Ensure spring groove faces up.



22154

a - Pressure plate
b - Spring groove

9. Lubricate end plate O-ring and place in second groove in housing.

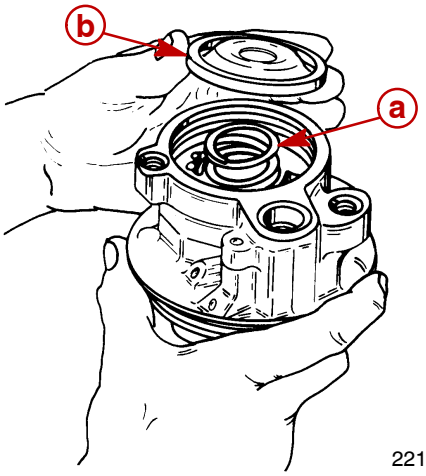


22150

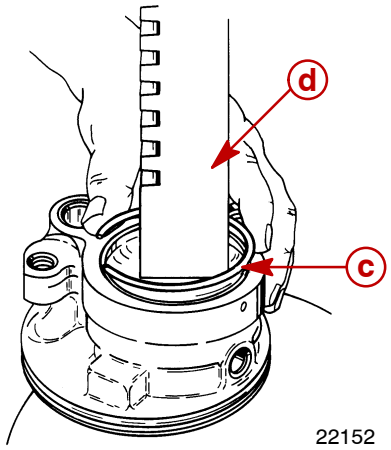
a - End plate O-ring

Description	Where Used	Part Number
Power Trim and Steering Fluid	End plate O-ring	92-802880A1

10. Install pressure plate spring, end plate, and retaining ring. Use care not to damage end plate and O-ring.



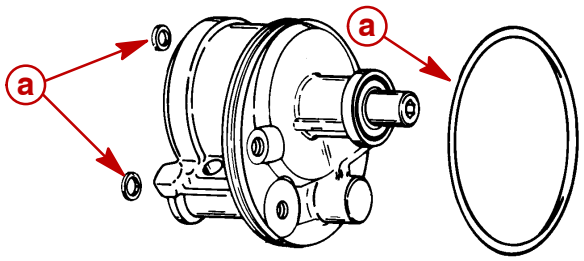
22151



22152

a - Pressure plate spring
b - End plate
c - Retaining ring
d - Arbor press

11. Lubricate reservoir O-rings and install in groove in pump housing.

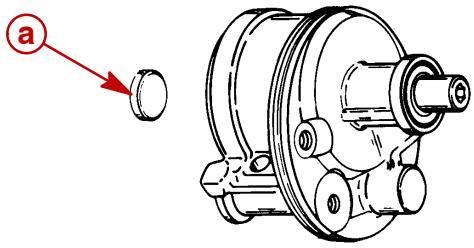


22153

a - Reservoir O-rings

Description	Where Used	Part Number
Power Trim and Steering Fluid	Reservoir O-rings	92-802880A1

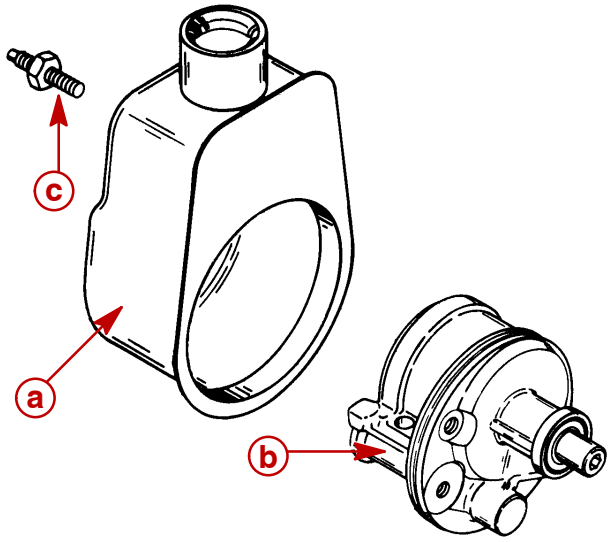
12. Place magnet on housing.



22153

a - Magnet

13. Secure reservoir to pump housing and torque studs.

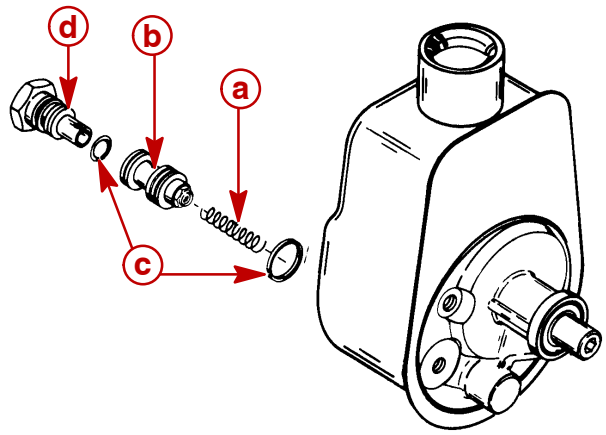


22153

a - Reservoir
b - Pump housing
c - Studs

Description	Nm	lb-in.	lb-ft
Power steering pump housing studs	47		35

14. Install components as shown. Torque fitting assembly.

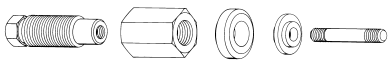


22153

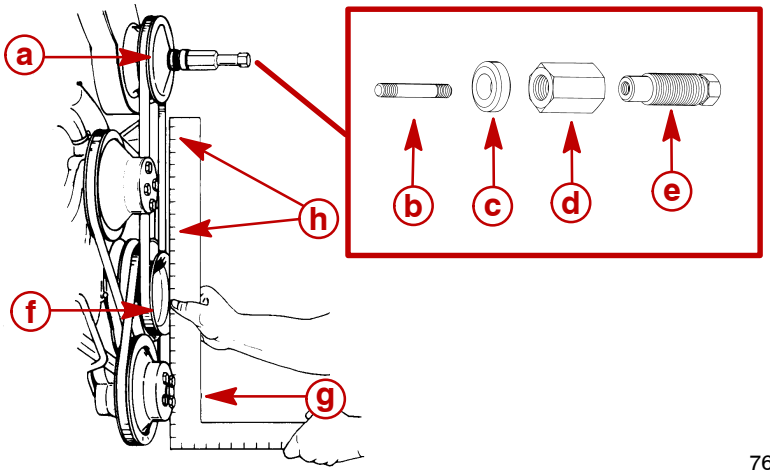
a - Flow control spring
b - Control valve assembly
c - O-ring for fitting assembly
d - Fitting assembly

Description	Nm	lb-in.	lb-ft
Fitting assembly	47		35

15. Install pulley using Pulley Pusher Installer and a long straight edge:
    a. Place pulley on pump shaft.
    b. Thread stud all the way into pump shaft. Place bearing over stud. Do not use spacer from kit.
    c. Thread nut onto shaft. Thread shaft and nut all the way onto stud.
    d. Using a long straight edge to check drive belt alignment, turn large pusher nut until drive belt is parallel to straight edge.

Pulley Pusher Installer		
 73670	Installs the pulley on the power steering pump.	91-93656A1

e. Check pulley installation for correct alignment. Do not use spacer.



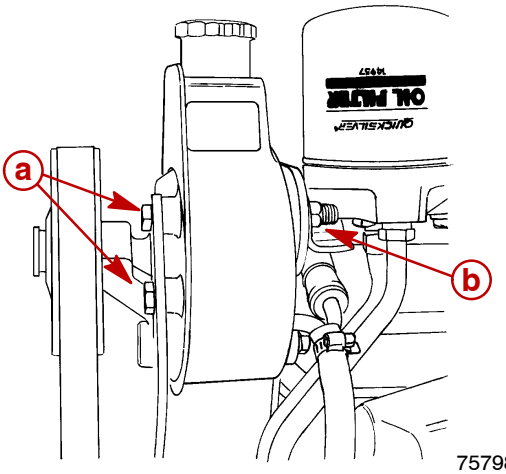
76896

a - Power steering pump pulley
b - Stud
c - Bearing
d - Nut
e - Shaft
f - Crankshaft pulley (shown) or water circulating pump pulley
g - Long straight edge
h - Drive belt parallel

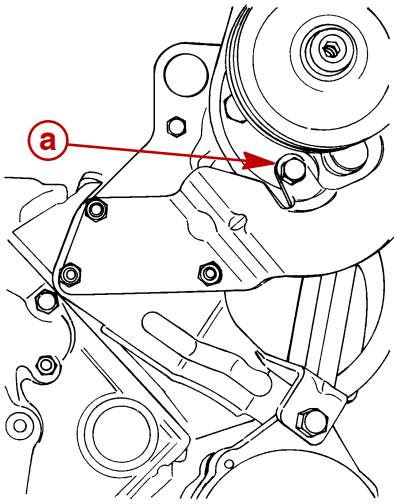
Installation

IMPORTANT: Be careful to not cross-thread or overtighten hose fittings.

1. Place the power steering pump on the bracket.
2. Install the bolt and nut and torque.



75798



75228

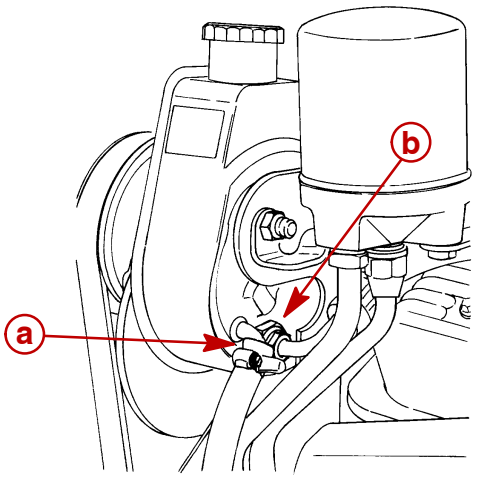
Power steering pump typical location

a - Nut
b - Bolts

Description	Nm	lb-in.	lb-ft
Power steering pump bolt and nut	41		30

3. Ensure that a new high pressure hose O-ring is present.
4. Install threaded fitting in back of pump assembly. Tighten fitting securely.

5. Connect low pressure return hose on back of pump. Tighten hose clamp securely.



75228

Power steering pump typical location

a - Return hose
b - High pressure hose

6. Install mounting hardware and fasteners to retain pump to bracket. (Refer to **Exploded View** for specific details on your engine.)
7. Install drive belt and adjust tension. Refer to **Pump Drive Belt Adjustment** as previously outlined.
8. Fill and air bleed system. Refer to **SECTION 1B - Maintenance**.

Multiple Sterndrive Steering Tie Bar Arrangements

With multiple sterndrives you must select one of several possible steering systems.

⚠ CAUTION

Failure to observe the recommended Tie Bar Arrangements as presented in this section could result in serious damage to the steering and/or trim system components. This damage could adversely affect control of the boat.

INTERNAL POWER STEERING WITH INTERNAL TIE BAR ONLY

At the lower end of the performance spectrum, boats not capable of speeds in excess of 97 km/h. (60 mph), the basic internal tie bar is recommended. It connects the slave sterndrive to the sterndrive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from the sterndrive manufacturer.

INTERNAL POWER STEERING WITH INTERNAL AND EXTERNAL TIE BAR

As a boat moves into the moderate performance range of 97-113 km/h. (60-70 mph) or for a reduction in steering backlash, an external tie bar should be added. External tie bars are usually designed to attach at the aft power trim cylinder bosses. This location is an excellent choice because of its proximity to the propeller. HOWEVER, because of the potential overstress that can occur if one sterndrive is trimmed much differently than the other, a dual trim control kit (Part Number 90362A3) should be installed to limit this potential tilt differential to about 20°.

IMPORTANT: Mercury Marine does not recommend the use of an external tie bar ONLY with no internal tie bar when using the internal power steering system. This can cause excessive loads on the steering components on the sterndrive connected to the internal power steering system. These increased loads can damage the steering components, resulting in increased play in the steering of the boat.

EXTERNAL POWER STEERING

When boat speeds move past 113 km/h (70 mph) or if additional steering backlash reduction is desired, external power steering is recommended. This normally will include an external tie bar mounted at the same general location as the power steering cylinders, which are generally attached at the top of the sterndrive's drive shaft housing. With this steering system, no internal tie bar should be used. These steering cylinders can be attached either inboard (between) or outboard of the sterndrives.

EXTERNAL POWER STEERING WITH LOW EXTERNAL TIE BAR

For the fastest boats, over 129 km/h (80 mph), or for the ultimate in steering backlash reduction, use external power steering, BUT (where mechanically possible) with the external tie bar mounted at the trim cylinder boss location (as previously described in "Internal Power Steering with Internal and External Tie Bar" statements). Again, this system does not use an internal tie bar.

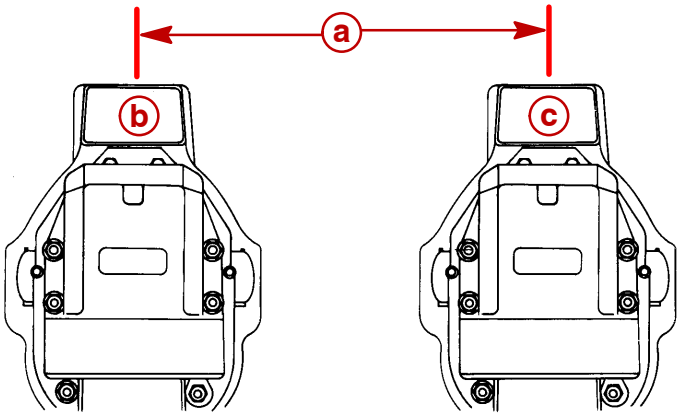
Determining Tie Bar Length

⚠ WARNING

ON DUAL INSTALLATION USING STARBOARD TIE BAR KIT. Bends or loops in the steering cable MUST have a minimum radius of 203 mm (8 in.) at the transom end. A radius less than 203 mm (8 in.) may kink the steering cable which, in turn, may affect steering operation. If the minimum 20.3 cm (8 in.) requirement cannot be met due to boat construction, etc., steering cable must then be routed to port transom and a port transom and a port tie bar kit 96708A4, A5, or A6 MUST BE used in place of the starboard tie bar kit.

NOTE: *If sterndrive units are to be angled-in or angled-out, measure from centerlines of steering levers (with sterndrive units positioned as desired), instead of centerlines of power packages. In most cases, the best boat handling and performance characteristics will be obtained with the sterndrive units positioned parallel.*

1. Determine tie bar length.
   a. Measure centerline distance (dimple in gimbal housing is located beneath the decal in the top center).
   b. Apply measurement to appropriate chart to determine tie bar length.



70133

a - Distance between centerlines
b - Port transom assembly centerline
c - Starboard transom assembly centerline

Tie Bar Selection

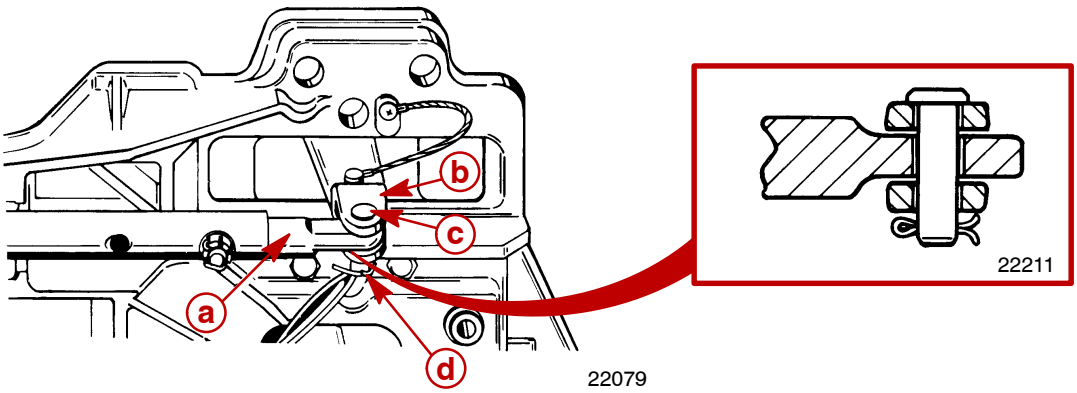
TIE BAR CHART For Dual Installations with Steering Cable Attached to Starboard Power Package	
*404.6-762 mm (16 to 30 in.)	92020A1
*762-1168.4 mm (30 to 46 in.)	92020A2
1168.4-1574.8 mm (46 to 62 in.)	92020A3
*If centerline distance is the same as maximum figure, use next larger size tie bar.	

TIE BAR CHART For Dual Installations with Steering Cable Attached to Port Power Package	
*711-952.5 mm (28 to 37-1/2 in.)	96708A4
*952.5-1397 mm (37-1/2 to 55 in.)	96708A5
1397-1828.8 mm (55 to 72 in.)	96708A6
*If centerline distance is the same as maximum figure, use next larger size tie bar.	

Tie Bar Installation

DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO STARBOARD POWER PACKAGE

1. Attach fixed bar end to steering lever using clevis pin and cotter pin. Spread cotter pin ends.



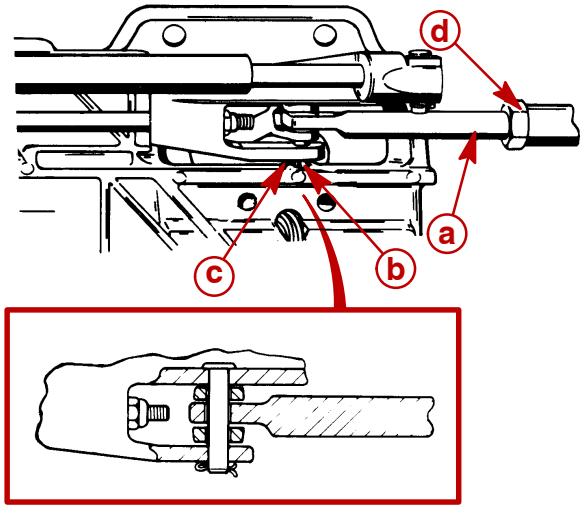
a - Fixed end
b - Steering lever
c - Clevis pin
d - Cotter pin

2. Position sterndrive units as desired and turn adjustable end out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis.

3. Turn adjustable end out 3 to 4 turns from this position.
4. Apply sealant to exposed tie bar threads.

Description	Where Used	Part Number
Loctite 277	Tie bar threads	Obtain locally

5. Thread tie bar in 3 to 4 turns to previously aligned position.
6. Attach tie bar end using clevis pin and cotter pin.
7. Spread cotter pin ends.
8. Apply sealant to exposed tie bar threads.
9. Torque locknut against tie bar.



22079

22211

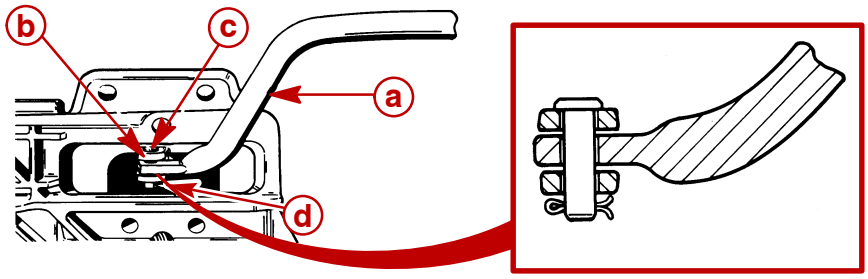
a - Adjustable end
b - Clevis pin
c - Cotter pin
d - Locknut

Description	Where Used	Part Number
Loctite 277	Tie bar threads	Obtain locally

Description	Nm	lb-in.	lb-ft
Tie bar locknut	68		50

DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO PORT POWER PACKAGE

1. Attach fixed bar end to steering lever using clevis pin and cotter pin. Spread cotter pin ends.



22211

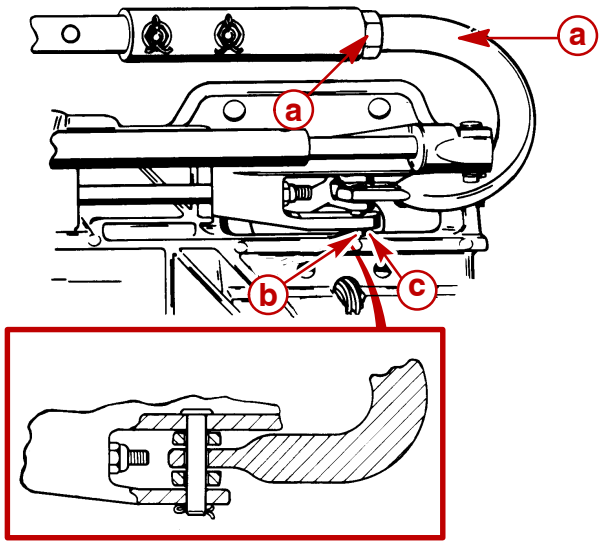
a - Fixed bar end
b - Steering lever
c - Clevis pin
d - Cotter pin

2. Position sterndrive units as desired and turn adjustable end out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis.
3. Turn adjustable end out 3 to 4 turns from this position.
4. Apply sealant to exposed tie bar threads.

Description	Where Used	Part Number
Loctite 277	Tie bar threads	Obtain locally

5. Thread tie bar in 3 to 4 turns to previously aligned position.
6. Attach tie bar end using clevis pin and cotter pin.
7. Spread cotter pin ends.

8. Apply sealant to exposed tie bar threads.
9. Tighten and torque locknut against tie bar.



22079

22211

a - Adjustable end
b - Clevis pin
c - Cotter pin

Description	Where Used	Part Number
Loctite 277	Tie bar threads	Obtain locally

Description	Nm	lb-in.	lb-ft
Tie bar locknut	68		50

STEERING SYSTEMS

Section 6B - Compact Hydraulic Steering

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6 B

Important Information About Through the Transom Exhaust

NOTICE
This hydraulic steering system is not designed for use with through the transom exhaust systems. Do not use this hydraulic steering system with a through the transom exhaust system.

Torque Specifications

NOTE: *Securely tighten all fasteners not listed below.*

Description	Nm	lb-in.	lb-ft
Hydraulic hose end O-ring area[1]	15	130	
Pivot bolts	34		25

[1] *Amount specified is MINIMUM. Do not exceed 22 Nm (200 lb-in.)*

Lubricants / Sealants / Adhesives

⚠ WARNING
Avoid serious bodily injury or death due to loss of steering control. Any non-approved fluid used in this system may cause irreparable damage, loss of steering, and cancellation of warranty. Never use brake fluid in this hydraulic steering system. Use only approved hydraulic fluids.

Description	Where Used	Part Number
Hydraulic Helm Steering Fluid	Hydraulic hose end O-ring area	92-862014Q1
	Hydraulic steering system	
Special Lubricant 101	Clevis pin and clevis	92-802865A1
	Bushings	
Hydraulic Helm Steering Fluid	Hydraulic Steering System	92-862014Q1
SeaStar® Hydraulic Fluid HA5430		Obtain locally
Chevron® Aviation Fluid		
Mobil® Aero HFA		
Shell® Aero 4		
Fluid meeting MIL Specification H5606C		

Introduction

The system design incorporates a pressure relief valve to protect against internal fluid pressure becoming greater than individual system components are capable of sustaining without bursting or similar failure. This design minimizes the possibility of total loss of steering.

The steering cylinder is referred to as an unbalanced cylinder. In any position there always remains a difference in the volume between port and starboard cylinder chambers. This is important when setting the hydraulic fluid level as outlined later.

This precision built product may not function properly if dirt or contaminants are introduced into the system.

⚠ CAUTION

Avoid product malfunction and diminished steering control. Dirt and contamination introduced into the hydraulic system can result in damage to internal parts of steering system. Do not allow dirt or contamination to enter the helm, lines or cylinder of this steering system.

IMPORTANT: Due to a small amount of internal hydraulic fluid transfer (slip), a master spoke or centered steering wheel cannot be maintained with a hydraulic steering system. For best results, use an equal distance spoke steering wheel.

⚠ WARNING

Avoid serious bodily injury or death due to loss of steering control. Extreme heat will lower burst pressure or melt hydraulic hoses. In either case, instant loss of steering may occur. Do not allow hydraulic hoses to contact hot engine.

Through the Transom Exhaust

This Compact Hydraulic Steering System is not designed for use with through the transom exhaust systems. Do not use this hydraulic steering system with a through the transom exhaust system.

Removal

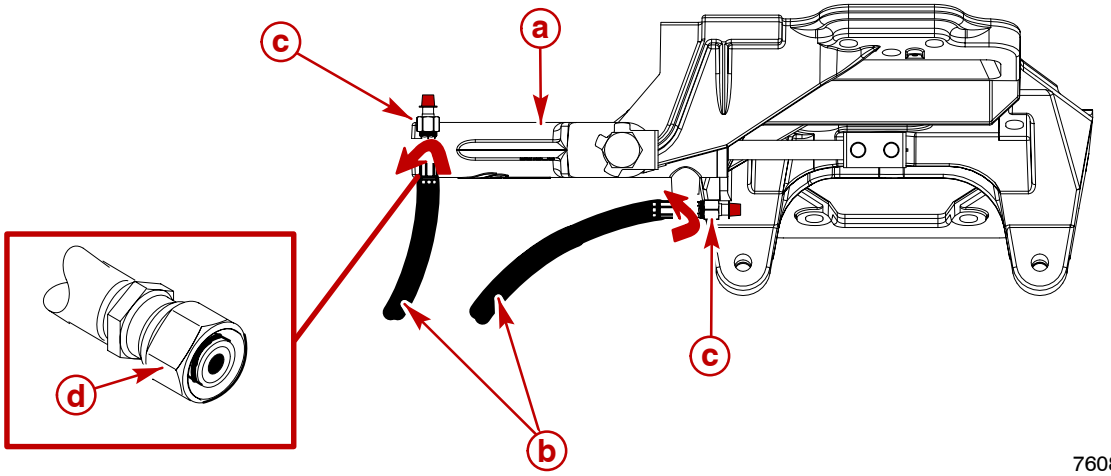
⚠ CAUTION

Avoid product malfunction and diminished steering control. Dirt and contamination introduced into the hydraulic system can result in damage to internal parts of steering system. Do not allow dirt or contamination to enter the helm, lines or cylinder of this steering system.

⚠ WARNING

Avoid serious bodily injury or death due to loss of steering control. Extreme heat will lower burst pressure or melt steering system hydraulic hoses. Stress on hose fittings or kinks in the hose may cause hose failure. In any case , instant loss of steering may occur. Route the hydraulic hoses to avoid extreme heat, stress on hose fittings, and hose kinks.

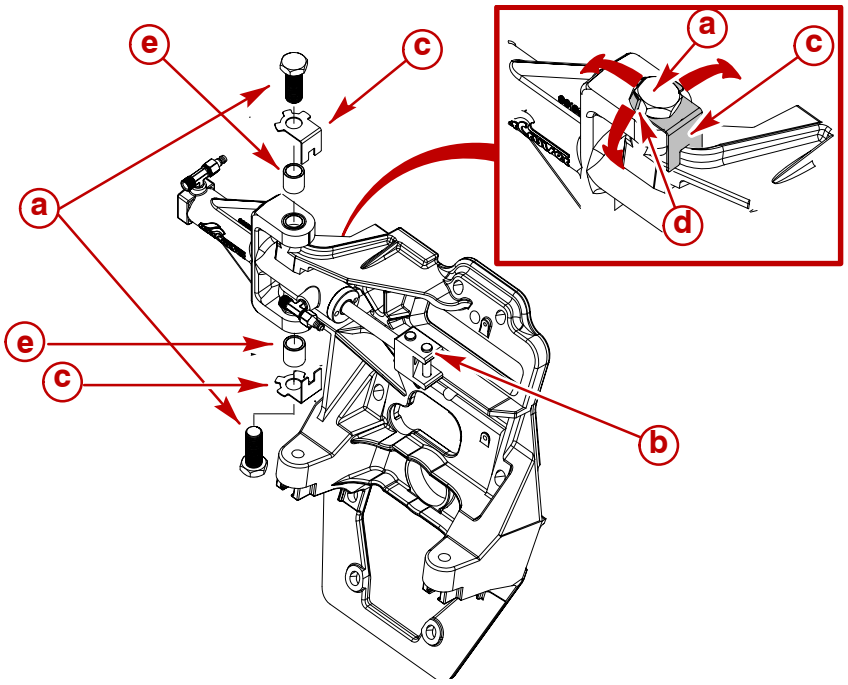
1. Loosen hose fittings and remove hoses from steering cylinder T-fittings.
2. Plug hose ends to prevent fluid loss.



76085

a - Steering cylinder
b - Hoses
c - T-fittings
d - Hose fittings

3. Remove cotter pin from port clevis pin and remove clevis pin.
4. Bend pivot bolt tab washer tabs away from bolts.
5. Remove pivot bolts.



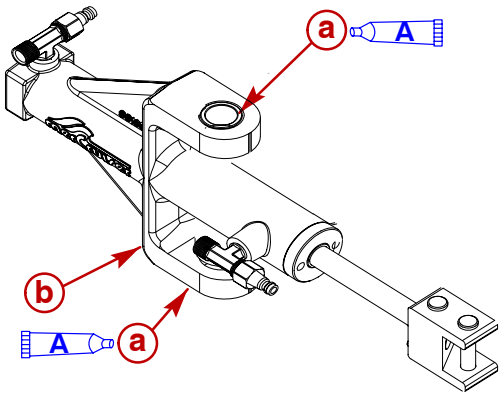
76087

a - Pivot bolts
b - Port clevis pin
c - Tab washer
d - Tab
e - Spacer / pivot bolt bearing

6. Remove steering cylinder from transom.

Installing The Steering Cylinder

1. Ensure that bushings are clean.
2. Lubricate the bushings.



76087

a - Bushings
b - Steering cylinder assembly

Description		Where Used	Part Number
A	Special Lubricant 101	Bushings	92-802865A1

3. Remove upper and lower pivot bolts, spacer, and tab washers. Ensure that threads are well lubricated.

Description	Where Used	Part Number
Special Lubricant 101	Upper and lower pivot bolts threads	92-802865A1

4. Install steering cylinder assembly as follows:

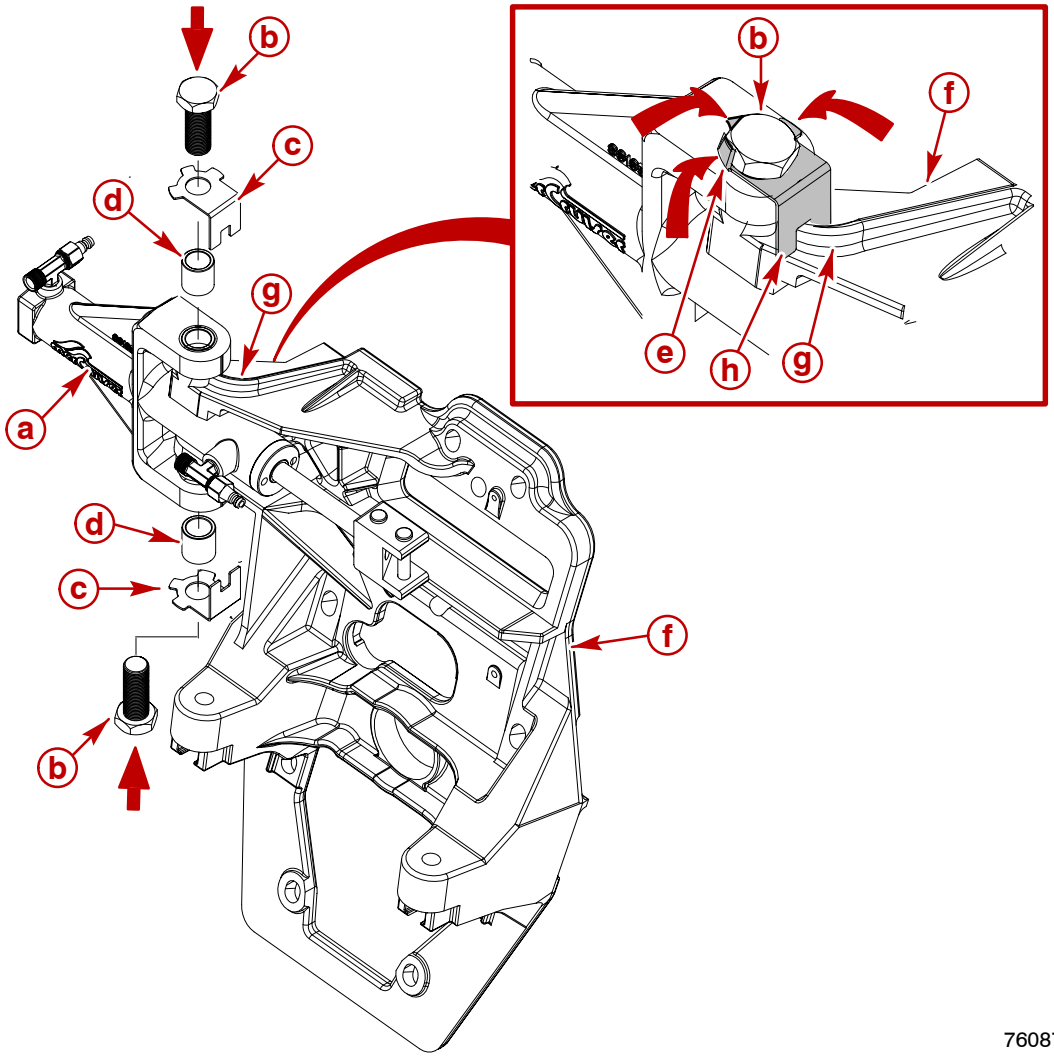
   a. Position steering cylinder assembly so that upper and lower pivot bolts (with tab washers and spacers) can be threaded by hand into transom plate.

   b. Ensure that tab washer tangs straddle the ridge on transom plate.

   c. Ensure steering cylinder assembly pivots freely.

   d. Torque pivot bolts. Bend washer tabs against corresponding flats on bolt heads.

NOTE: *It may be necessary to tighten pivot bolts further to align flats on bolt with tabs on tab washer.*



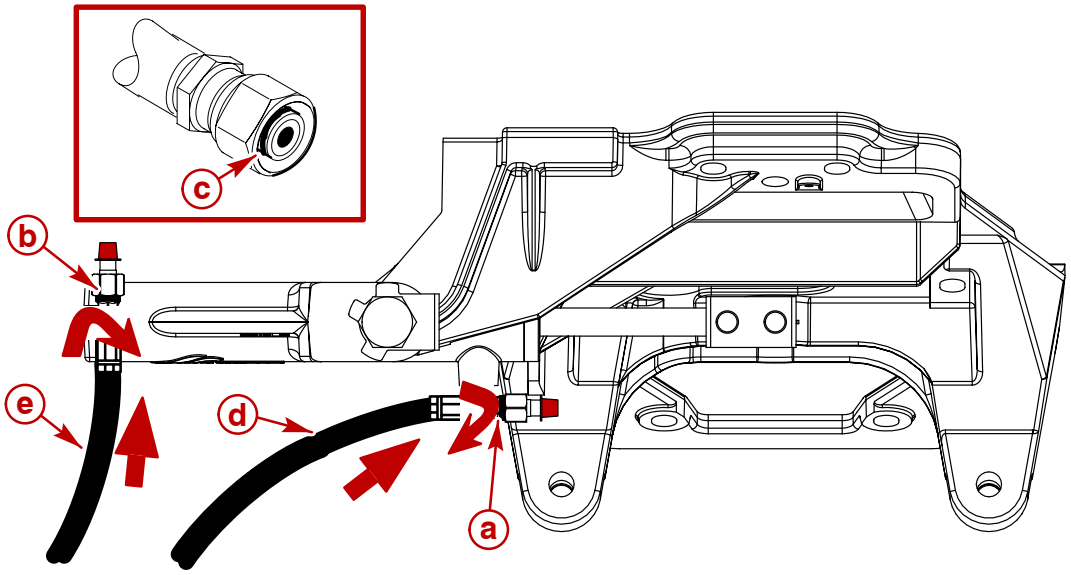
76087

a - Steering cylinder assembly
b - Pivot bolt
c - Tab washer
d - Spacer
e - Tab
f - Transom plate
g - Ridge on transom plate
h - Tab washer tangs (straddle ridge)

Description	Nm	lb-in.	lb-ft
Pivot bolts	34		25

IMPORTANT: Do not connect clevis to steering lever at this time. Bleed and purge the system before connecting clevis to steering lever.

5. Connect hoses to steering cylinder as follows:
   a. Apply a small amount of clean lubricant to the hydraulic hose end O-ring area.
   b. Push port and starboard hoses completely into fittings.
   c. Hand tighten hose fittings.
   d. Torque hose fittings.



76085

a - Port T-fitting
b - Starboard T-fitting
c - Hose O-ring
d - Port hose from helm (“P”)
e - Starboard hose from helm (“S”)

Description	Where Used	Part Number
Hydraulic Helm Steering Fluid	Hydraulic hose end O-ring area	92-862014Q1

Description	Nm	lb-in.	lb-ft
Steering hydraulic hose fittings[1]	15	130	

[1] *Amount specified is MINIMUM. Do not exceed 22 Nm (200 lb-in.)*

Filling And Purging The System

NOTE: *Due to system design, one technician may not be able to completely purge all the air from the system after installation. This will result in spongy and unresponsive steering. Two technicians are required for successful filling and purging of any system.*

Twin Station and/or Twin Cylinder

⚠ WARNING

Avoid serious injury or death resulting from a loss of steering control. Improper venting or plugging of hydraulic helm pump reservoir can cause loss of fluid or introduction of air into hydraulic system resulting in insufficient hydraulic pump pressure for proper steering control. If more than one steering station is being installed, the vent/fill plug on all but the uppermost helm must be replaced with a non-vent plug which is included in a dual station fitting kit.

For twin station and/or twin cylinder filling and purging (bleed) instructions, follow instructions provided by SeaStar®. Refer to single station with single cylinder for instruction on how to fill and purge a single station with single cylinder system.

Single Station With Single Cylinder

FILLING

IMPORTANT: Hydraulic fluid must be visible in the filler tube during the entire filling procedure. Do not allow the bottle of fluid used for filling to empty causing the filler tube to empty. This may introduce air into the system and cause additional filling and purging to be needed.

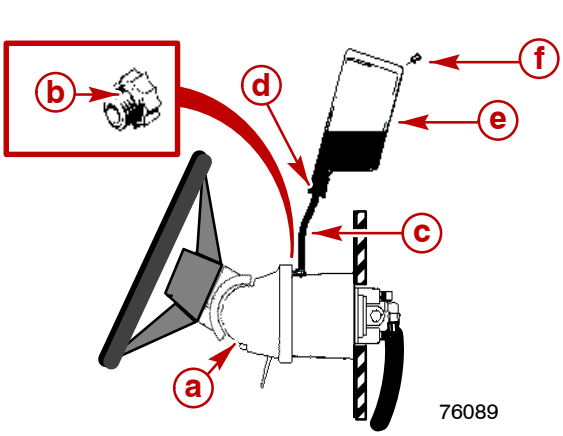
Approximately 2 bottles (2 quarts or liters) of approved hydraulic fluid are required for this single station and single cylinder system. The length of hydraulic hoses required will cause the amount to vary.

1. Remove vent/fill plug from helm.
2. Using a Filler Kit (ordered separately), screw the filler tube into vent/fill plug hole. Hand tighten.
3. Screw bottle of hydraulic fluid into the filler tube bottle cap end. Turn bottle upside down and poke a hole in bottom of bottle.

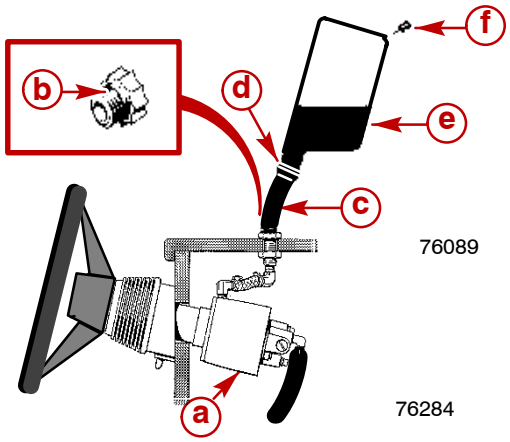
Description	Where Used	Part Number
Hydraulic Helm Steering Fluid	Hydraulic steering system	92-862014Q1

4. Ensure hydraulic fluid is always visible in filler tube and fill helm pump. Install next bottle while fluid is still visible in filler tube but first bottle is empty.

5. The helm is full when air bubbles no longer appear in filler tube. Stop filling.



Standard helm



Sport helm

a - Helm
b - Vent fill plug
c - Filler tube
d - Bottle cap end
e - Hydraulic fluid bottle
f - Pin (to pierce bottle)

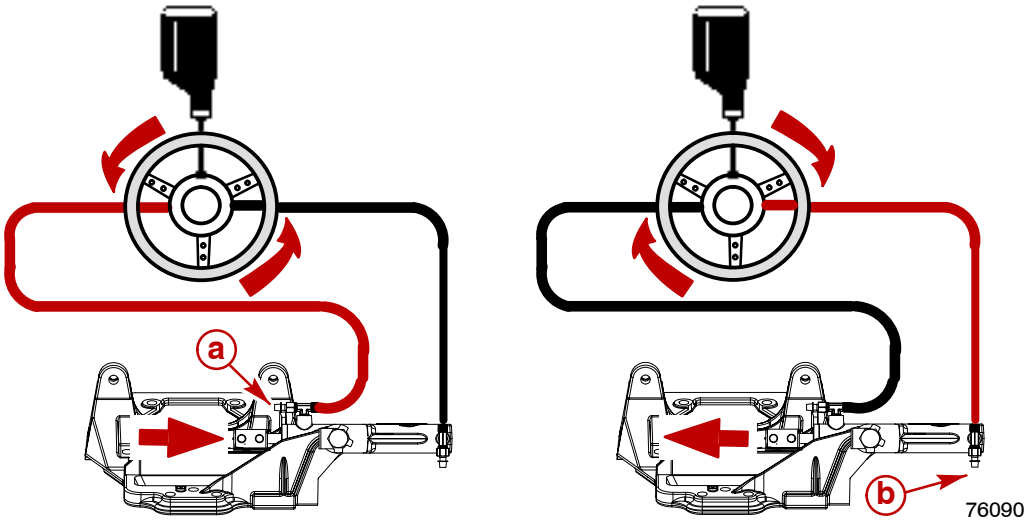
Description	Where Used	Part Number
Hydraulic Helm Steering Fluid	Hydraulic steering system	92-862014Q1

IMPORTANT: Do not proceed to the next step until helm is full of hydraulic fluid. Ensure that no air is visible in filler tube.

6. Leave bottle of fluid connected to helm for use in purging system of air.

Purging

NOTE: *Turning the steering wheel in direction shown moves the cylinder rod as indicated by arrow.*

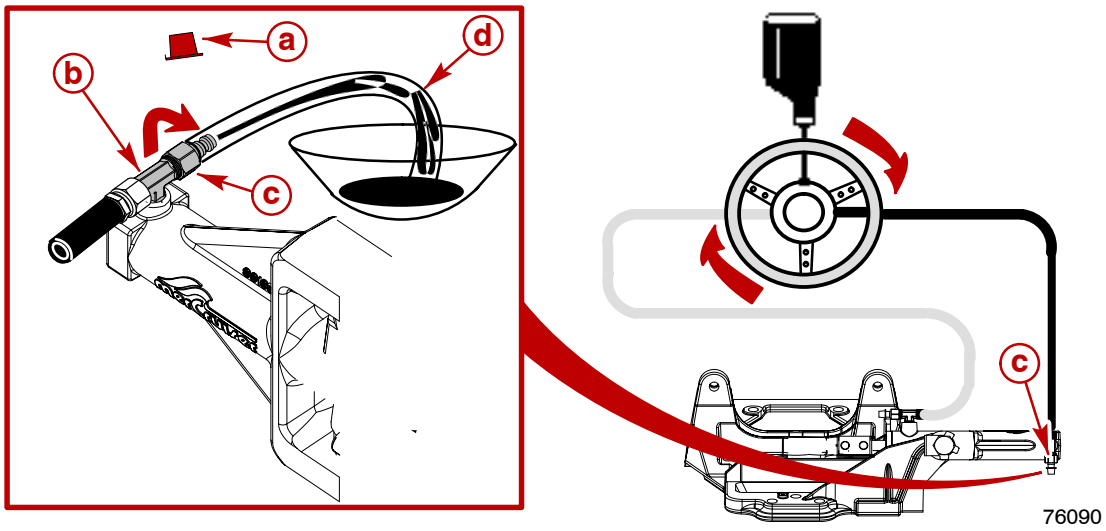


a - Port bleeder valve
b - Starboard bleeder valve

1. Remove caps from bleeder valves on T-fittings at cylinder assembly.

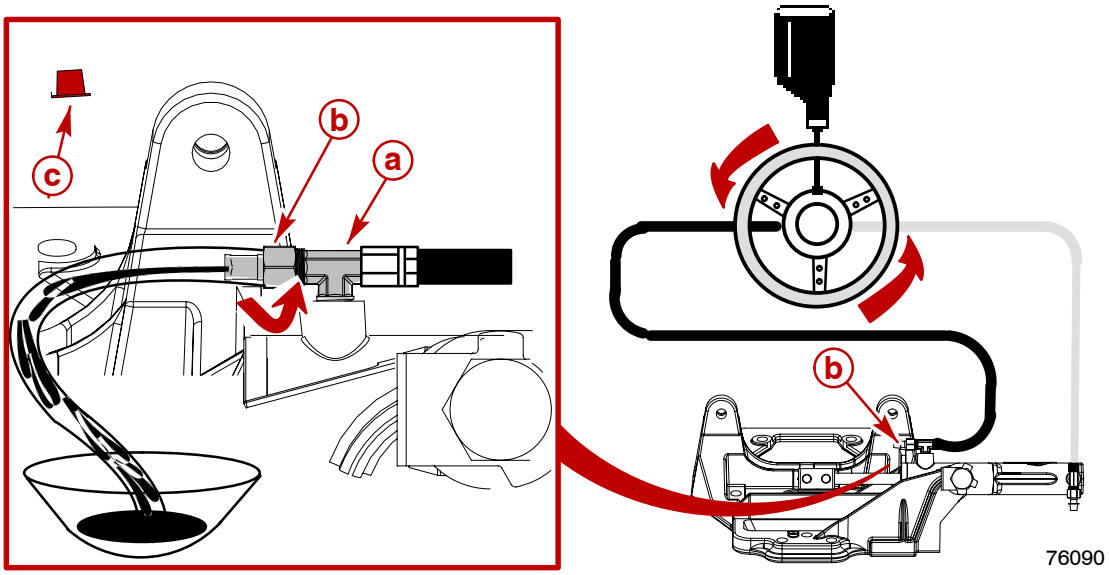
NOTE: *Place temporary hoses (obtain locally - clear hose is recommended) on bleeder outlets and position these hoses in a container to avoid spills and air returning to bleeder.*

2. Turn the steering wheel slowly CLOCKWISE while your assistant opens the STARBOARD bleeder valve.
3. Continue to turn steering wheel CLOCKWISE until a stream of air-free hydraulic fluid is visible out of bleeder.



a - Cap
b - Starboard fitting
c - Starboard bleeder valve
d - Temporary hose

4. While continuing to slowly turn the steering wheel, close the STARBOARD bleeder.
5. Turn steering wheel CLOCKWISE until cylinder rod is fully extended. Ensure that the steering lever does not interfere with cylinder clevis.
6. Turn the steering wheel slowly COUNTERCLOCKWISE while your assistant opens the PORT bleeder valve on the steering cylinder.
7. Continue to turn steering wheel until a stream of air-free fluid is visible out of bleeder.
8. Continuing to slowly turn the steering wheel while closing the PORT bleeder.
9. Turn the steering wheel COUNTERCLOCKWISE until the cylinder rod is fully retracted. Steering wheel will come to a stop.
10. Open STARBOARD bleeder.
11. Hold cylinder rod to prevent extension. Continue to turn steering wheel COUNTERCLOCKWISE until a stream of air-free fluid is visible out of bleeder.
12. Close the bleeder while continuing to turn steering wheel.
13. Filling and purging is complete. Refer to Hydraulic Fluid Level to set fluid level and to check the system after connecting the clevis.



a - Starboard T-fitting
b - Starboard bleeder valve
c - Cap

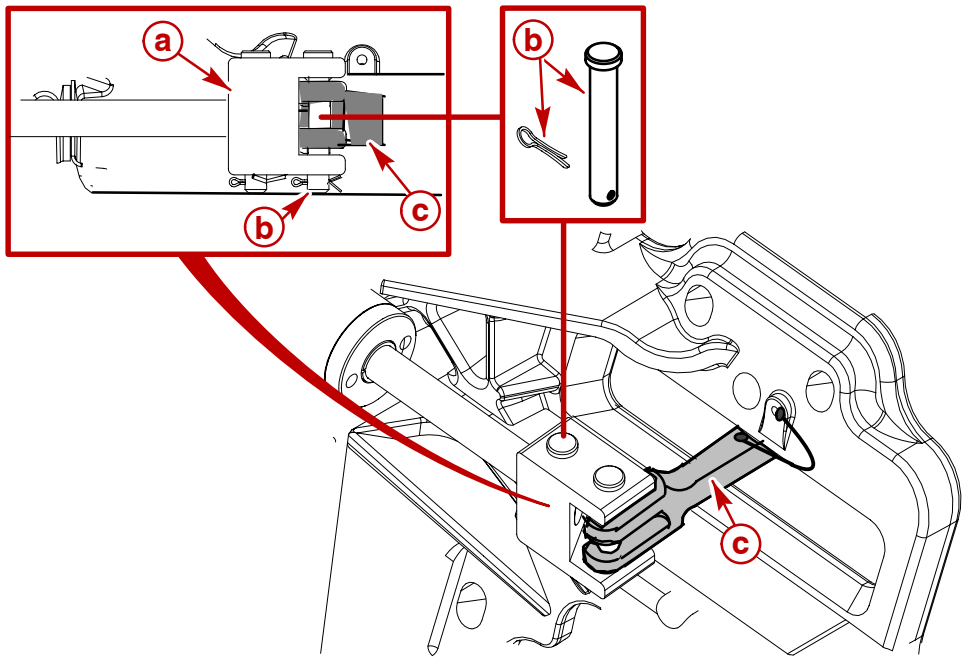
Connecting The Clevis

1. Lubricate clevis pin and clevis.

Description	Where Used	Part Number
Special Lubricant 101	Clevis pin and clevis	92-802865A1

2. Connect clevis to steering lever. Spread both ends of cotter pin.

IMPORTANT: Ensure that the clevis is positioned as shown below. The angled notch in the clevis must face the rear.



76087

a - Clevis
b - Clevis pin and cotter pin
c - Steering lever

Hydraulic Fluid Level

⚠ WARNING

Avoid serious bodily injury or death due to loss of steering control. This system operates with an unbalanced steering cylinder volume. Proper fluid level in the helm can only be set or checked with the cylinder rod fully retracted. Do not set or check hydraulic fluid level in helm with cylinder rod extended.

Setting Fluid Level

System must be filled and purged as outlined previously before setting fluid level.

1. Ensure cylinder rod is fully retracted.
2. With filler tube screwed into helm filler plug hole, fill tube approximately 1/2 full of air-free fluid.
3. Open starboard bleeder valve and slowly turn steering wheel CLOCKWISE until fluid level in filler tube is at the top of the plastic filler fitting. Continue turning steering wheel CLOCKWISE 1/4 turn more and stop. Close bleeder.
4. Remove filler tube. Fluid level should be at bottom of filler hole. Install vent/fill plug.

Maintaining Fluid Level

To maintain proper fluid level, observe the following:

- Do not allow fluid level to drop more than 6 mm (1/4 in.) below bottom of filler hole.
- Check fluid level periodically.

System Check

The system must be checked for proper connections, possible leaks, and complete purging of air after filling, purging, and setting the fluid level.

IMPORTANT: In the following, turn the wheel with enough force to exceed the pressure relief valve in the helm. This should not harm the helm or the system.

1. Turn steering wheel (any wheel on multi-steering station) very hard to port to pressurize system.
2. While pressure is maintained, check all port fittings and hose connections. Ensure that there are no leaks. If leaks are present, correct before using.
3. Turn steering wheel (any wheel on multi-steering station) very hard to starboard to pressurize system.
4. While pressure is maintained, check all starboard fittings and hose connections. Ensure that there are no leaks. If leaks are present, correct before using.

NOTE: *Observing a significant drop in the fluid level at the helm while performing the system check may mean you are compressing air and further filling and purging would be required.*

5. If no leaks are present, the system is ready for service.

Maintenance

⚠ WARNING

Avoid serious bodily injury or death due to loss of steering control. Failure to comply with maintenance checks may result in a loss of hydraulic pressure due to insufficient hydraulic fluid, or proper mechanical function necessary for steering control.

Task	Interval
Check the hydraulic fluid level in the helm pump.	A minimum of two times a year, or at the first sign or indication that the steering system is not operating normally or correctly; whichever occurs first.
Check for leaks.	
Check mechanical linkages and connections. Tighten loose parts and replace badly worn parts.	
Check cylinder shaft for nicks and scratches.2	

[2] *A damaged cylinder shaft can cause seal failure and leaks. Replacing seals on a damaged cylinder assembly will not stop leaks. A damaged cylinder shaft must be replaced immediately.*

Troubleshooting Guide

Important Information

Whenever a troubleshooting solution calls for removal from vessel and/or dismantling of steering system components, such work must be carried out by a qualified marine mechanic. The following is offered as a guide only and neither Mercury MerCruiser nor the helm manufacturer are responsible for any consequences resulting from incorrect repairs.

Most faults occur when the installation instructions are not followed and usually show up immediately upon filling the system. The following trouble shooting chart provides the most common faults encountered and their likely cause and solution.

Sometimes when returning the steering wheel from a hard-over position, a slight resistance may be felt and a clicking noise may be heard. This should not be mistaken as a fault, as it is a completely normal situation caused by the releasing of the lockspool in the system.

⚠ WARNING

Avoid serious injury or death due to FIRE or EXPLOSION. Ensure that engine compartment is well ventilated and that no gasoline vapors are present to prevent the possibility of a FIRE or EXPLOSION.

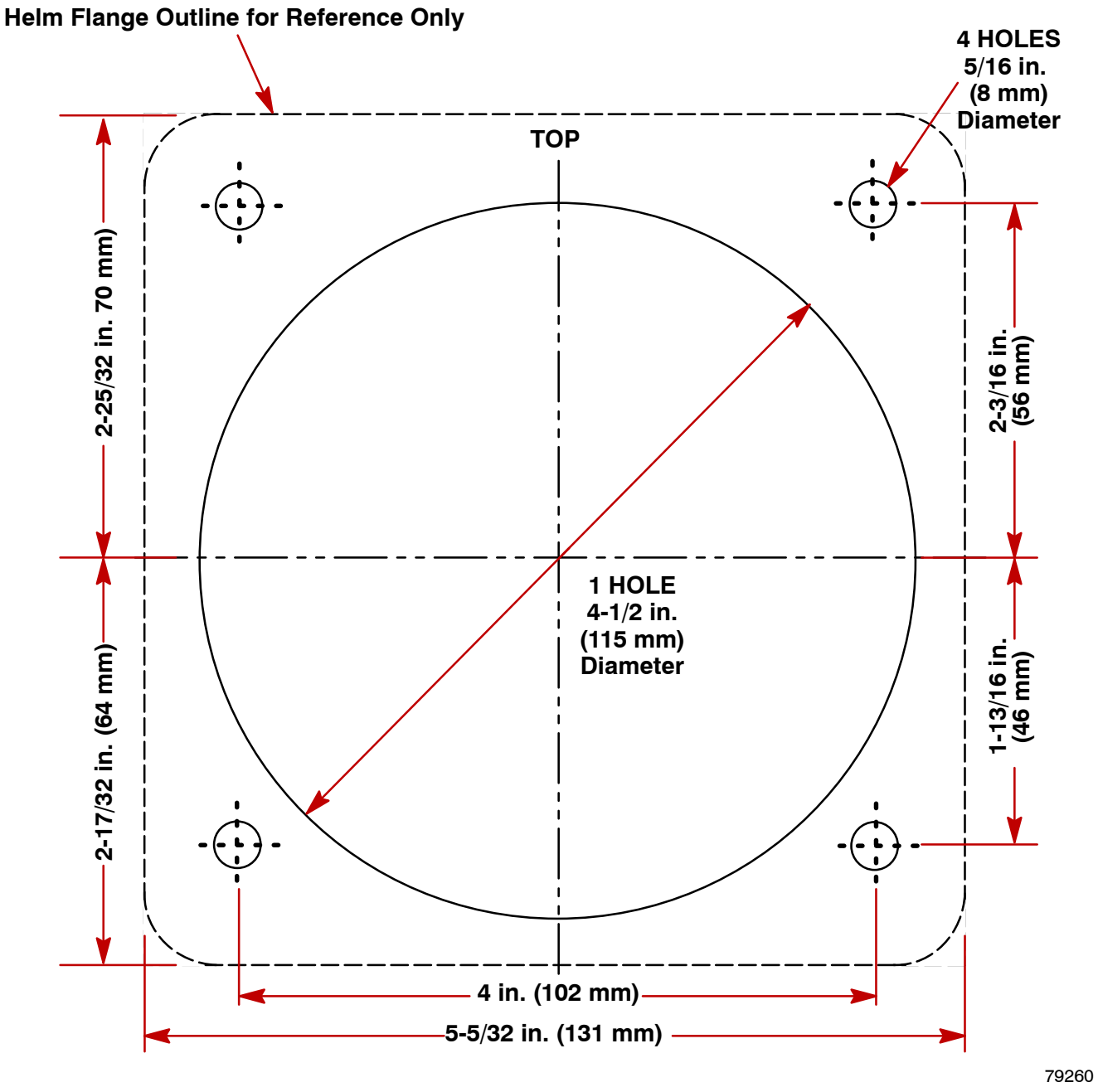
Troubleshooting Chart

Symptom	Cause	Solution
1. During filling, the helm becomes completely jammed.	A. Blockage in the line between the helms and the cylinders.	A. Ensure that hoses were not kinked or pinched during installation. If so, the hose must be removed and replaced.
2. System is very difficult to fill. Air keeps burping out top of helm even after system appears full.	A. Air in system.	A. Review filling instructions.
3. Steering is stiff and hard to turn, even when the vessel is not moving.	A. Steering cylinder pivot bushings are too tight or trunnion is bent, causing mechanical binding.	A. To test, disconnect clevis from steering lever and turn the steering wheel. If it does not turn easily, correct mentioned causes. Please note that excessively loose connections to steering cylinder or steering lever can also cause mechanical binding.
	B. Restrictions in hoses.	B. Find restrictions and correct.
	C. Air in hydraulic fluid.	C. Refer to filling and purging instructions.
	D. Wrong hydraulic fluid has been used to fill steering system.	D. Drain system and fill with approved hydraulic fluid.
4.The helm unit, or one in the system, is very bumpy and requires too many turns from port hard-over to starboard hard-over.	A. Dirt in inlet check of helm pump.	A. Replace helm unit.

Troubleshooting Chart (continued)

Symptom	Cause	Solution
5. Steering is easy to turn at the dock, but becomes hard to turn when vessel is underway.	A. Steering wheel is too small.	A. Fit larger wheel if possible, see installation instructions. If the problem cannot be rectified by the above mentioned solution, proceed with next cause and solution or consult factory.
	B. Incorrect setting of trim tabs, if equipped.	B. Adjust tabs, if equipped.
6. Drive drifts to port or starboard while vessel is underway, even when wheel is not being turned.	A. Dirt in check valves.	A. Remove check valve plugs. These are the larger plugs on either side on rear of helm. Clean ball seats and balls and reassemble. ***Note:*** *Be prepared to lose a certain amount of hydraulic fluid during this procedure. Have a small can available. Refill system when check balls have been re-assembled.*
7. Turning one wheel causes second wheel to rotate.	A. Refer to Number 6.	A. Refer to Number 6.
8. Seals will sometimes leak if steering system is not vented at uppermost helm.	A. Refer to Solution.	A. The helm has a field replaceable wheel shaft seal that can readily be replaced by removing the steering wheel and seal cover held in place by three small screws. Quad ring No. 210 is found in Seastar® Helm Seal Kit HS5151.
9. Vent/fill plug leaks when turning to port.	A. Cylinder rod extended during filling.	A. Ensure cylinder rod is retracted during filling.

Standard Tilt Helm Mounting Template



CORROSION PROTECTION

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Torque Specifications

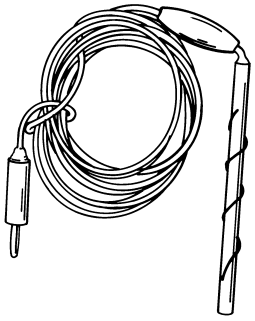
NOTE: *Securely tighten all fasteners not listed below.*

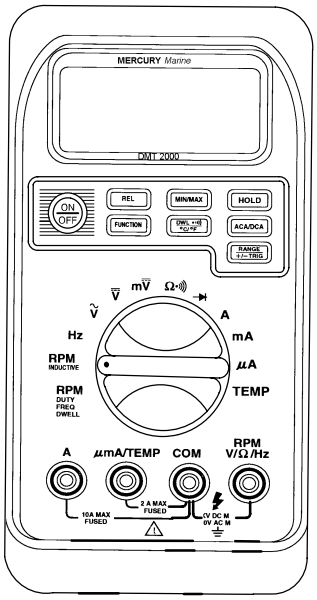
Description	Nm	lb-in.	lb-ft
Anodic plate screw	41		30
MerCathode assembly mounting screws	2.8	25	

Lubricants / Sealants / Adhesives

Description	Where Used	Part Number
Liquid Neoprene	All electrical connections	92-25711-3
Mercury Phantom Black	Bare metal	92-802878-1
Special Lubricant 101	Propeller shaft	92-802865A1
2-4-C with Teflon		92-802859A1
Anti-Corrosion Grease		92-802867A1

Special Tools

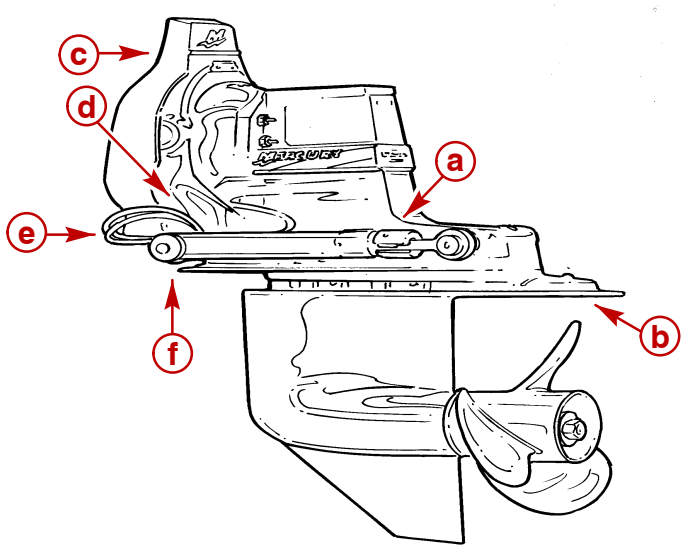
Reference Electrode		
 73446	Senses an electrical current in the water when testing the MerCathode System. Use to check hull potential.	91-76675T1

DMT 2000A Tachometer / Multi-Meter Kit[1]		
 77959	Measures rpm on both 2 and 4 cycle marine engines, records the maximums and minimums simultaneously and will read accurately in high RFI environments. Replacement components: 91-854010-1 Inductive Pick-Up 8 ft (2.4 m) 91-854011-1 Temperature Probe 91-854012 Ferrite Core 91-854013-1 Interface Module 91-854014-1 Hard Carrying Case 91-854015-1 User's Guide 91-802651 Test Leads Optional Accessories: 84-854016T 8 ft. (2.4 m) Inductive Pick-Up Extension 91-802650-1 Clamp-On Current Probe 91-89045-1 Direct Voltage Adapter	91-854009A3

[1] **If you do not already have this meter, use a digital multi-meter. Do not use a standard analog meter as inaccurate readings will result.*

NOTE: *Quicksilver Volt/Ohm Multi-Meter DVA/Tester 91-99750A1 is no longer recommended for testing corrosion protection.*

General Information



78283

Standard Bravo sterndrive unit

- **a** - Sacrificial trim cylinder anode
- **b** - Sacrificial anode / anodic plate
- **c** - Steering lever ground wire
- **d** - Ground wire between gimbal ring and bell housing
- **e** - Stainless steel hoses
- **f** - Ground wire between gimbal ring and gimbal housing

The following maintenance items are recommended to ensure that your sterndrive unit stays corrosion free.

- Maintain a complete paint covering on the sterndrive unit.
- Check the finish regularly and prime and paint nicks and scratches using Mercury enamel paint and touch up paint. Use only tin based anti-fouling paint on or near aluminum surfaces below the waterline.
- If bare metal is showing, apply 2 coats of paint.

Description	Where Used	Part Number
Mercury Phantom Black	Bare metal	92-802878-1

- Spray all electrical connections with sealant.

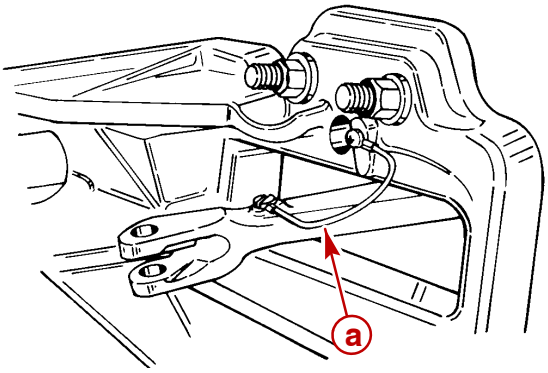
Description	Where Used	Part Number
Liquid Neoprene	All electrical connections	92-25711-3

- Inspect the sacrificial trim tab at regular intervals and replace it before it is half gone. If a stainless steel prop is installed, additional anodes or a MerCathode System will be required.
- Inspect the prop shaft for fishing line, which can cause corrosion on stainless steel shaft.
- Remove propeller at least every 60 days and lubricate the propeller shaft.
- Do not use lubricants containing graphite on or near aluminum in salt water.
- Do not paint trim tabs or the mounting surface.

Continuity Circuit

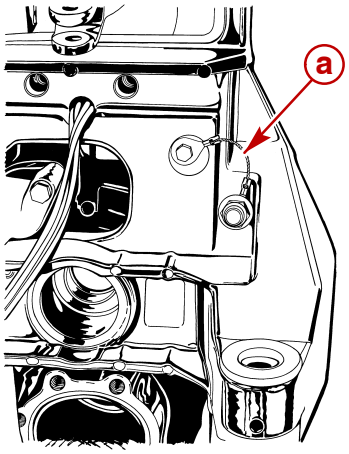
The transom assembly and sterndrive unit are equipped with ground circuit wires to ensure good electrical continuity between engine, transom assembly, and sterndrive components. Good continuity is essential for the anode and MerCathode System to function most effectively.

1. Inspect the following ground circuit components at intervals for loose connections or broken or fraying wires.



22028

a - Steering lever ground wire



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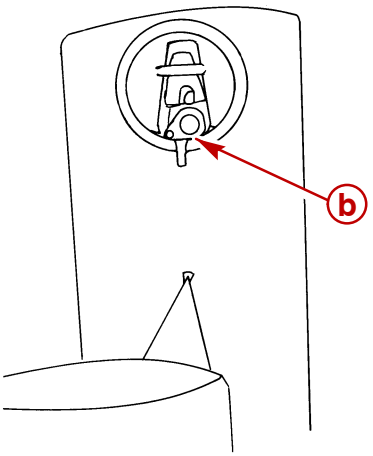
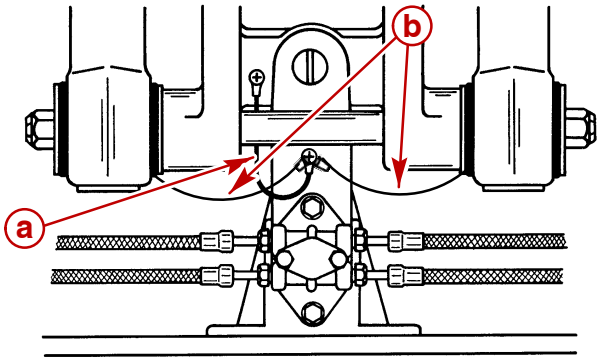


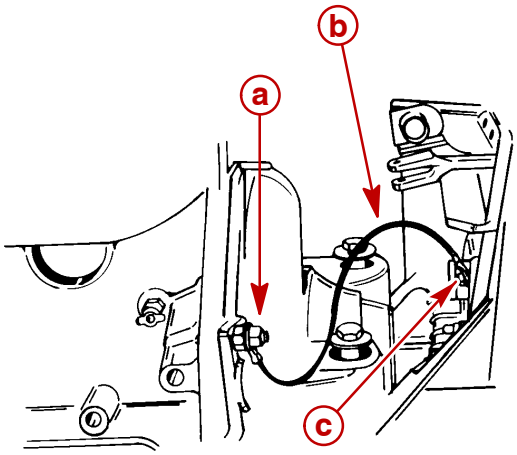
77079

a - Inner transom plate to gimbal housing ground wire
b - Drive shaft housing to gear housing ground plate (inside anode cavity)



77100

a - Gimbal housing to gimbal ring ground wire
b - Gimbal housing to trim cylinder ground wires



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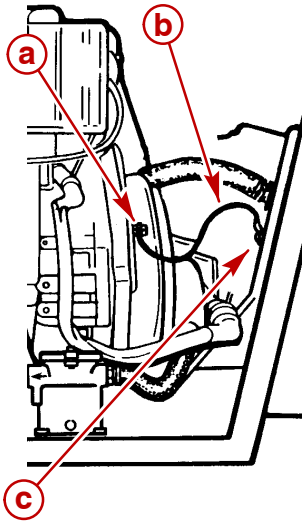
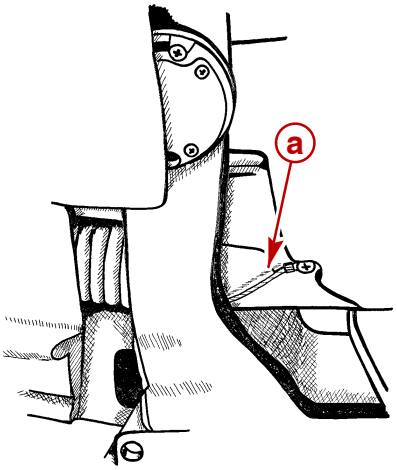


50242

Gasoline models

Diesel models

a - Flywheel housing grounding stud
b - Ground wire
c - Inner transom plate grounding screw



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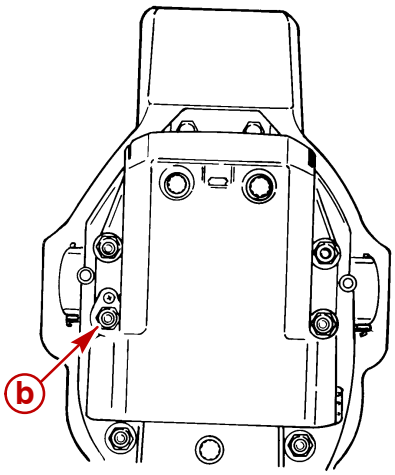
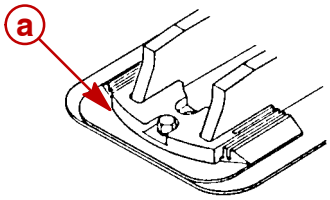
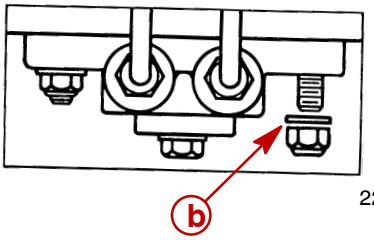


22031

a - Gimbal ring to bell housing ground wire
b - Sterndrive unit to bell housing ground plate

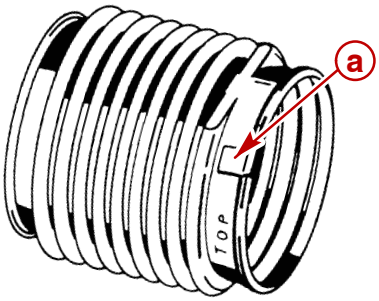


70575



22230

a - Drive shaft housing anodic plate
b - Continuity washers between fasteners and hydraulic manifold block to gimbal housing



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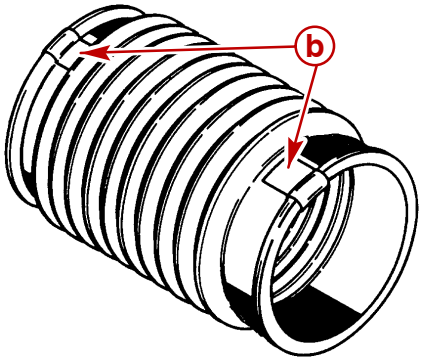


22079

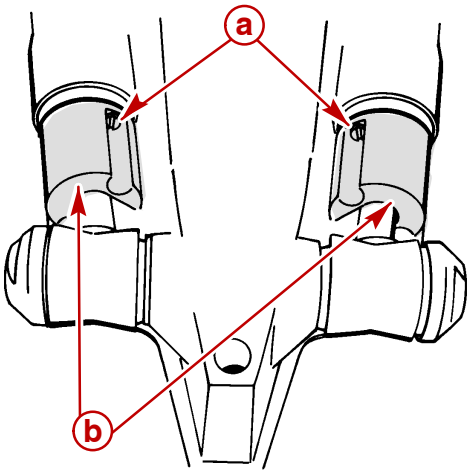
a - U-joint bellows ground clip
b - Exhaust bellows ground clips

Trim Cylinder Anodes

⚠ CAUTION

Do not paint new trim cylinder anodes as this will render them ineffective as a galvanic corrosion inhibitor.

1. Remove screws that secure anodes to trim cylinders.
2. Remove anodes.



71966

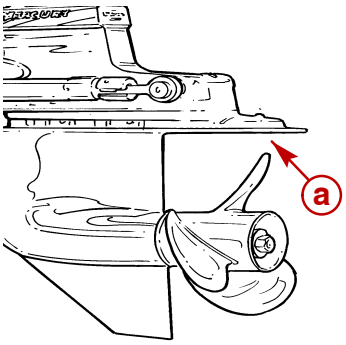
a - Screws
b - Trim cylinder anodes

3. Clean thread holes with a 10-32 standard tap.
4. Install new anodes and tighten securely.

Anodic Plate

⚠ CAUTION

Do not paint new anodic plate as this will render it ineffective as a galvanic corrosion inhibitor.



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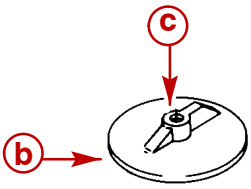
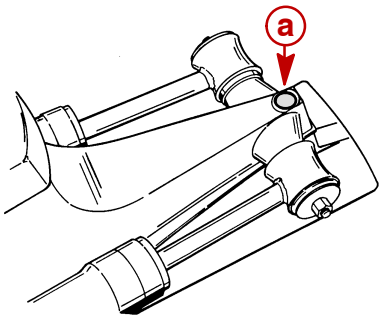


75251

a - Anodic plate location
b - Anodic plate
c - Threaded boss (up)

Bravo One Sterndrive Units

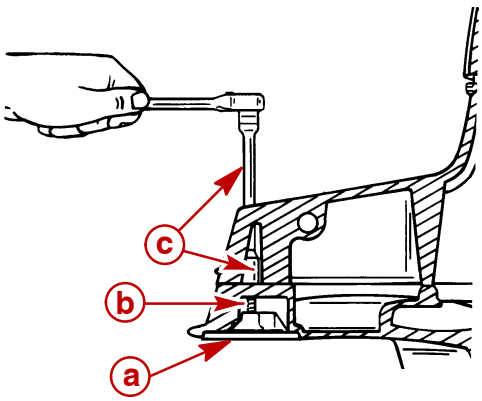
1. Remove plug from drive shaft housing to gain access to attaching screw.



22093

a - Rubber plug or plastic cap

2. Loosen screw and remove anodic plate.



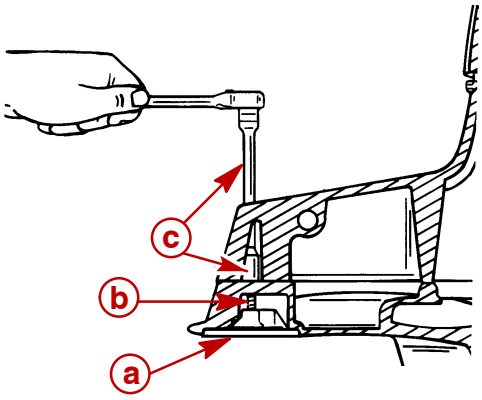
76800

a - Anodic plate
b - Screw
c - Socket and extension

⚠ CAUTION

To be effective, new anodic plate must make good electrical contact with gear housing.

3. Install anodic plate, screw, and continuity washer. Torque screw.

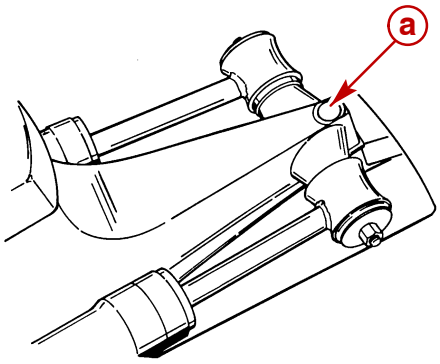


76800

a - Anodic plate
b - Screw
c - Socket and extension

Description	Nm	lb-in.	lb-ft
Anodic plate screw	41		30

4. Reinstall plug in drive shaft housing.

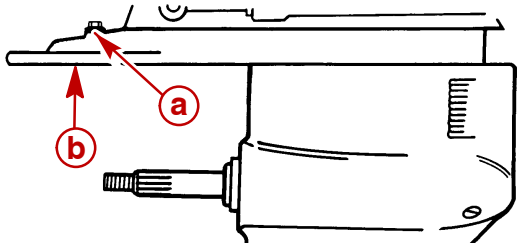


22093

a - Rubber plug or plastic cap

Bravo Two Sterndrive Units

1. Loosen screw and remove anodic plate.
2. Install anodic plate, screw, and continuity washer. Torque screw.



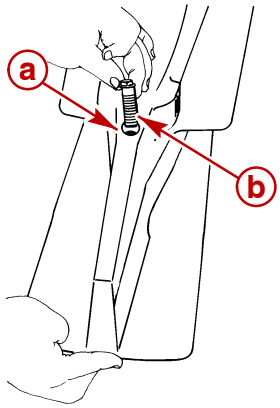
50323

a - Screw
b - Anodic plate

Description	Nm	lb-in.	lb-ft
Anodic plate screw	41		30

Bravo Three Sterndrive Units

1. Remove plastic cap to gain access to the anode attaching screw.



76832

a - Plastic cap (removed)
b - Screw

2. Install new anode and continuity washer. Torque screw.

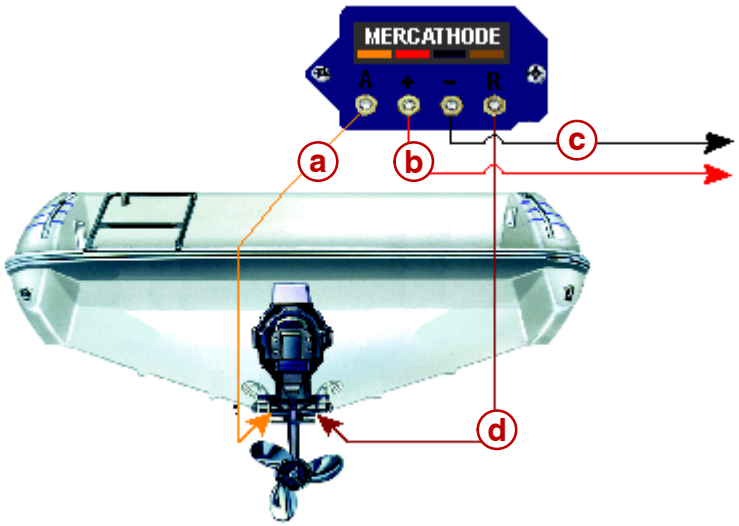
Description	Nm	lb-in.	lb-ft
Anodic plate screw	41		30

3. Reinstall plastic cap.

Integral MerCathode System

The MerCathode System automatically protects the drive unit from corrosion. The increased output provides greater protection for underwater aluminum parts. Its reliable, efficient operation requires an insignificant amount of current when protection is needed.

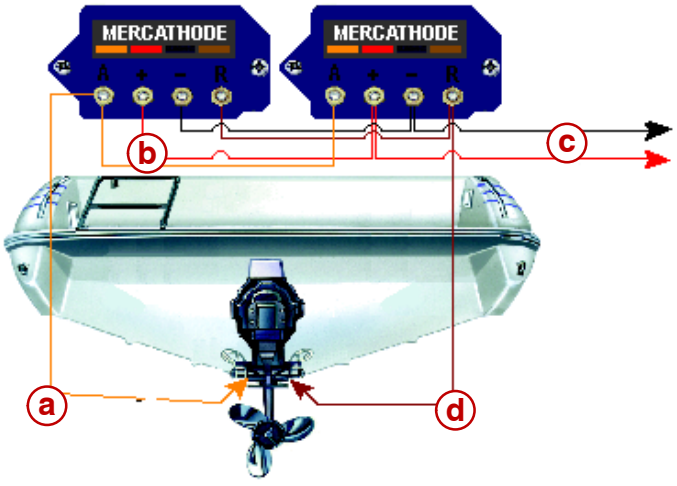
The blue MerCathode controller output is limited to approximately 200 mA to avoid rapid drain of the boat's battery.



79094

Single MerCathode application

In saltwater, a second MerCathode System blue controller may be added in parallel to increase protection to 400 mA. Please note that this will also increase the drain on your battery. Refer to the ***Mercury Precision Parts / Marine Corrosion Protection Guide*** *(90-881813003).*



79095

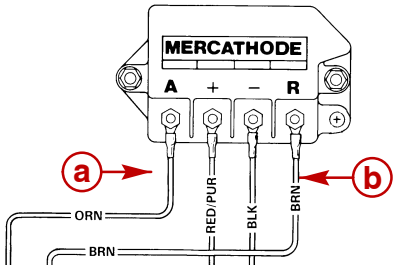
Dual MerCathode application

- **a** - ORANGE lead - from anode on transom assembly
- **b** - RED/PURPLE lead - connect to positive (+) battery terminal
- **c** - BLACK lead - from engine harness
- **d** - BROWN lead - from reference electrode on transom assembly

Removing Gimbal Mounted MerCathode Assembly

The Hull Potential Test should be performed to ensure that the system is functioning properly. Refer to Corrosion Protection Testing and Troubleshooting following in this section.

1. Disconnect MerCathode assembly wires from MerCathode controller or disconnect the quick connect terminals.

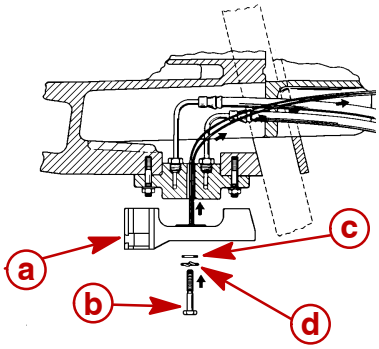


74251

Standard controller shown

a - Lead to anode of MerCathode assembly (ORANGE)
b - Lead to reference electrode of MerCathode assembly (BROWN)

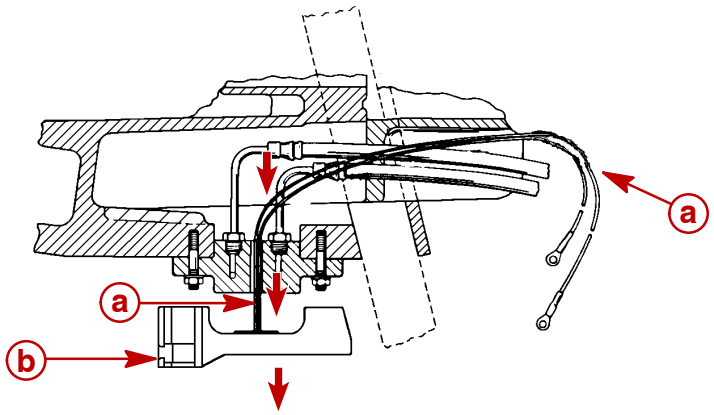
2. Remove the two mounting screws and washers holding the MerCathode assembly to the gimbal housing.



70771

a - MerCathode assembly
b - Screw (2)
c - Flat washer (2)
d - Lockwasher (2)

3. Gently remove the MerCathode assembly and wires from the gimbal housing.



70771

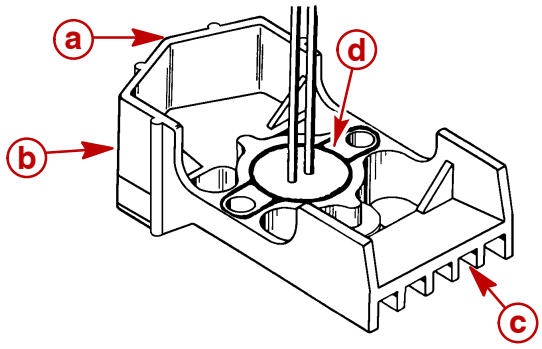
a - MerCathode assembly wires
b - MerCathode assembly

Installing Gimbal Mounted MerCathode System

⚠ CAUTION

Rubber seal must be properly seated in groove of electrode assembly or water leakage into boat will result.

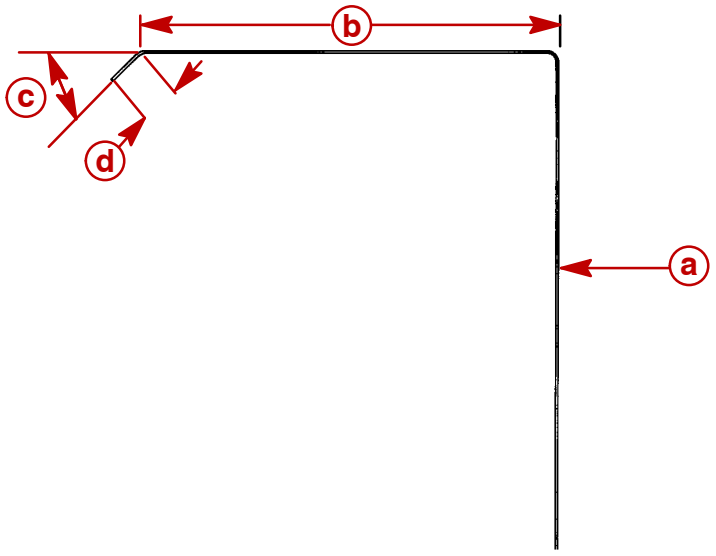
1. The gimbal mounted MerCathode assembly has a factory installed rubber seal and does not require an O-ring.



71862

a - MerCathode assembly
b - Anode
c - Reference electrode
d - Rubber seal

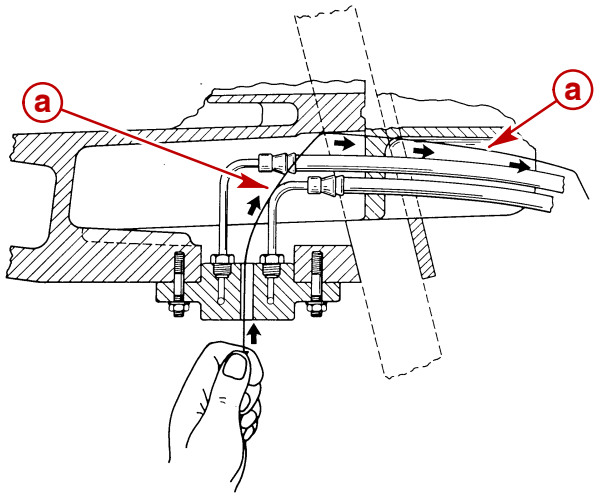
2. Form a 61 cm (2 ft) long piece of 0.8 mm (0.032 in.) diameter wire to the dimensions shown.



74106

a - 61 cm (2 ft) of approximately 0.8 mm (0.032 in.) diameter wire
b - 12.3 cm (5 in.)
c - 45 degree angle
d - 13 mm (1/2 in.)

3. Insert 45 degree angle end of wire through center hole in hydraulic connector block.
4. Guide wire through hole until wire protrudes through cavity at the bottom of exhaust pipe.



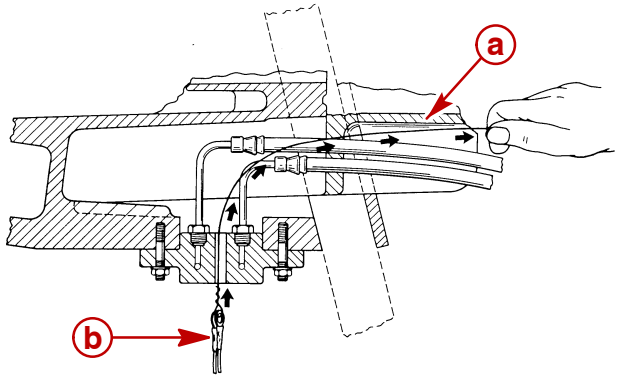
22235

a - Wire

5. Secure ring terminals to guide wire.
6. Guide leads through center hole in connector block.

IMPORTANT: ORANGE lead is approximately 15 cm (6 in.) longer than the BROWN lead.

7. Pull leads into the boat.



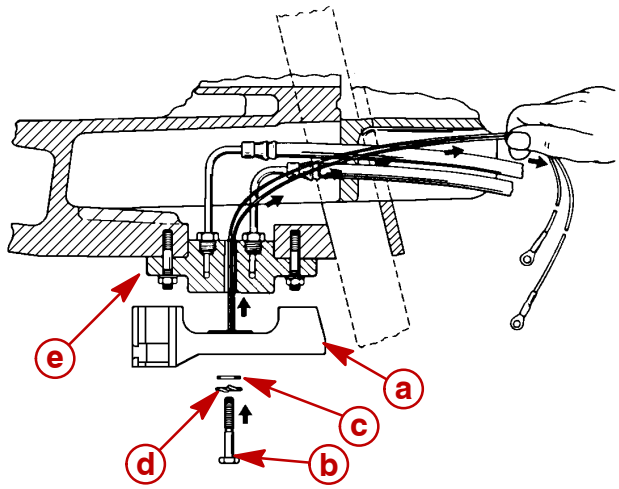
22234

a - Guide wire
b - Leads

⚠ CAUTION

Do not paint sacrificial anodes or MerCathode System anode/reference electrode assembly, as this will render them ineffective as galvanic corrosion inhibitors.

8. Position and secure MerCathode assembly to gimbal housing using two 35 mm (1-3/8 in.) long screws, flat washers, and lockwashers.
9. Torque screws. Do not overtighten.



70771

a - MerCathode assembly
b - Screw (2)
c - Flat washer (2)
d - Lockwasher (2)
e - Hydraulic connector block

Description	Nm	lb-in.	lb-ft
MerCathode assembly mounting screws	2.8	25	

Connect to MerCathode Controller Assembly

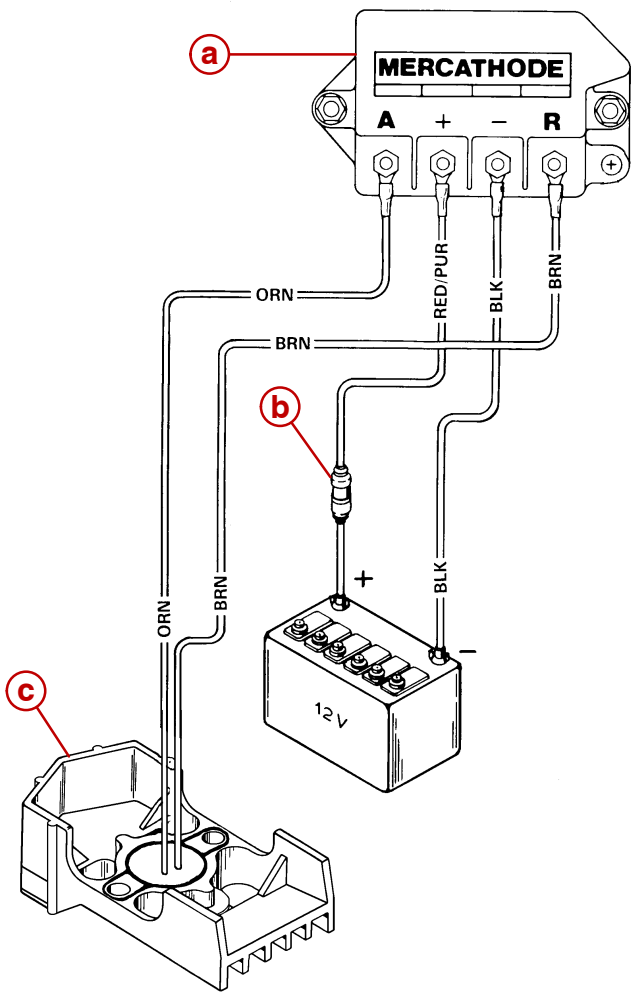
NOTE: *If BLACK (ground) wire is not available at terminal block or from wire harness, install a separate lead between controller negative (–) terminal and negative (–) battery cable attaching point on engine.*

1. Securely connect electrical leads to MerCathode controller assembly. (See **Wiring Diagrams**.)
2. Apply a thin coat of sealant to all electrical connections.

Description	Where Used	Part Number
Liquid Neoprene	All electrical connections	92-25711-3

Wiring Diagrams

MerCathode Controller - Standard Models

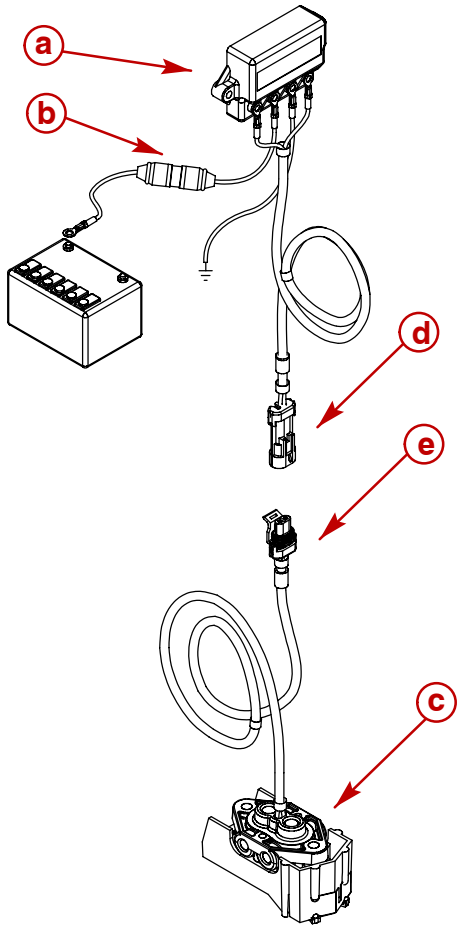


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

73596

a - MerCathode controller
b - 20 Amp fuse
c - MerCathode assembly

MerCathode Controller - Quick Connect Models



79133

a - MerCathode controller
b - 20 Amp fuse
c - MerCathode assembly
d - Female terminal
e - Male terminal

Galvanic Isolator

Boats that are connected to AC shore power require additional protection to prevent destructive low voltage galvanic currents from passing through the shore power ground wire. A Quicksilver Isolator 888557Q01 can be installed to block the passage of these currents, while still providing a path to ground for dangerous fault (shock) currents.

⚠ CAUTION

If AC shore power is not isolated from boat ground, the MerCathode System and sacrificial anodes may be unable to handle the increased galvanic corrosion potential.

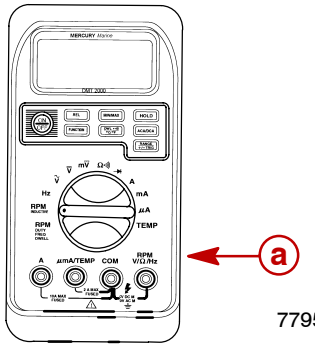
Corrosion Protection Testing and Troubleshooting

NOTE: *The following corrosion protection test supersedes all previously issued tests. This test can be used on applications with or without a MerCathode System.*

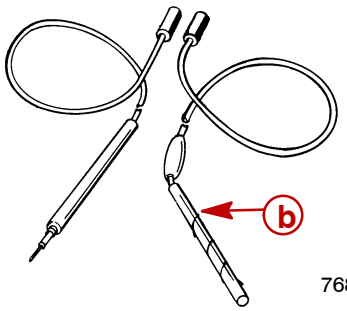
If the unit is equipped with a MerCathode System, this test should be performed annually where the boat is moored to ensure that the system is functioning properly.

Test requires the use of MerCathode Reference Electrode and a digital multi-meter. A STANDARD ANALOG METER CANNOT BE USED, AS AN INACCURATE READING WILL RESULT.

The MerCathode Reference Electrode Tester is equipped with a special connector containing a resistor to provide the proper scale reading when used with a digital multimeter. **Do not remove this plug or use analog meters.** Resistor jack can be left in place when using digital meters.



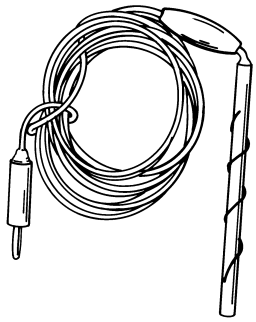
77959

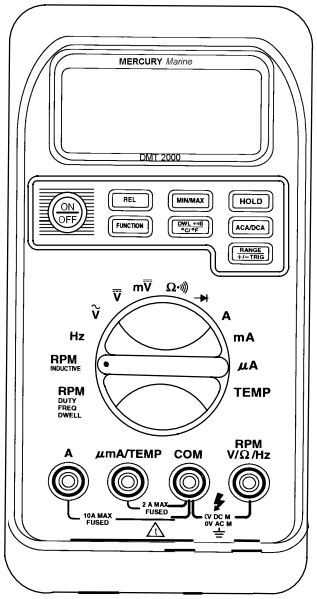


76834

Digital Multimeter and MerCathode Reference Tester

a - DMT 2000A Tachometer / Multi-Meter
b - Reference Electrode

Reference Electrode		
 73446	Senses an electrical current in the water when testing the MerCathode System. Use to check hull potential.	91-76675T1

DMT 2000A Tachometer / Multi-Meter Kit		
 77959	Measures rpm on both 2 and 4 cycle marine engines, records the maximums and minimums simultaneously and will read accurately in high RFI environments. Replacement components: 91-854010-1 Inductive Pick-Up 8 ft (2.4 m) 91-854011-1 Temperature Probe 91-854012 Ferrite Core 91-854013-1 Interface Module 91-854014-1 Hard Carrying Case 91-854015-1 User's Guide 91-802651 Test Leads Optional Accessories: 84-854016T 8 ft. (2.4 m) Inductive Pick-Up Extension 91-802650-1 Clamp-On Current Probe 91-89045-1 Direct Voltage Adapter	91-854009A3

IMPORTANT: If equipped with MerCathode System, ensure that battery is fully charged (12.6 volts or above).

IMPORTANT: Boats recently placed in service usually will produce a reading higher than normal because the sterndrive unit is protected by a good finish and new sacrificial anodes. To obtain an accurate diagnosis, the test should be performed after the boat has been in service at least one or two weeks. This will give the paint a chance to soak and minor abrasions and scratches will have appeared resulting in a more accurate reading.

IMPORTANT: Boats should be moored, without being operated, for at least 8 hours before performing tests. This is necessary to allow the MerCathode System and/or sacrificial anodes to polarize the surrounding water. Be careful not to rock the boat excessively while boarding to perform a test as this will alter the test reading.

1. Set meter on scale required to read 0-2000 millivolts.
2. Connect the negative meter lead to the negative (–) battery terminal or other convenient engine ground.
3. Connect Reference Electrode Tester lead into positive (+) receptacle of meter.
4. Immerse Electrode Tester in the water within 15 cm (6 in.) of aft end of sterndrive unit.

IMPORTANT: There will be different voltage readings depending on the type of MerCathode System you are testing.

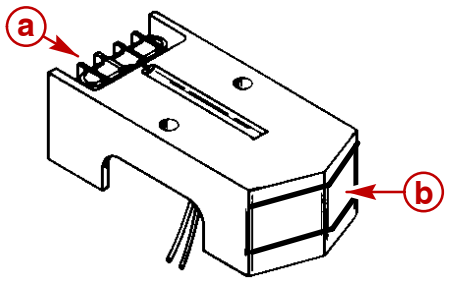
5. The following readings indicate the corrosion protection status of the sterndrive unit. Refer to **Section 1C - Troubleshooting.**

	Digital Multi-Meter	Corrosion Protection
Freshwater	Between 750 - 1050 millivolts	Sterndrive is protected
	Below 750 millivolts	Sterndrive is corroding
	Above 1050 millivolts	Sterndrive is overprotected

	Digital Multi-Meter	Corrosion Protection
Salt, Polluted, or Mineral Laden Water	Between 850 - 1100 millivolts	Sterndrive is protected
	Below 850 millivolts	Sterndrive is corroding
	Above 1100 millivolts	Sterndrive is overprotected

Continuity Test

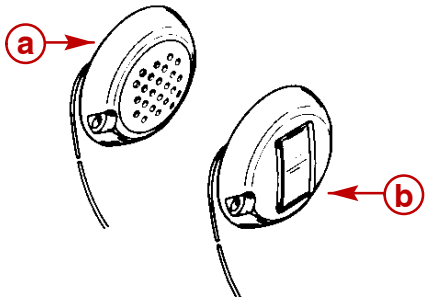
1. Connect the end of the positive meter lead to each metallic component on the sterndrive. Ensure that there is good electrical contact to each metal surface. Reading should drop below 2 millivolts.
2. A reading higher than 2 millivolts indicates improper grounding.
3. If the reading is not within specified limits, or if reading is within specifications but there is evidence of corrosion on sterndrive unit, refer to the following troubleshooting charts to aid in diagnosis.



76868

Gimbal mounted MerCathode on bottom of transom assembly

a - Anode
b - Reference electrode

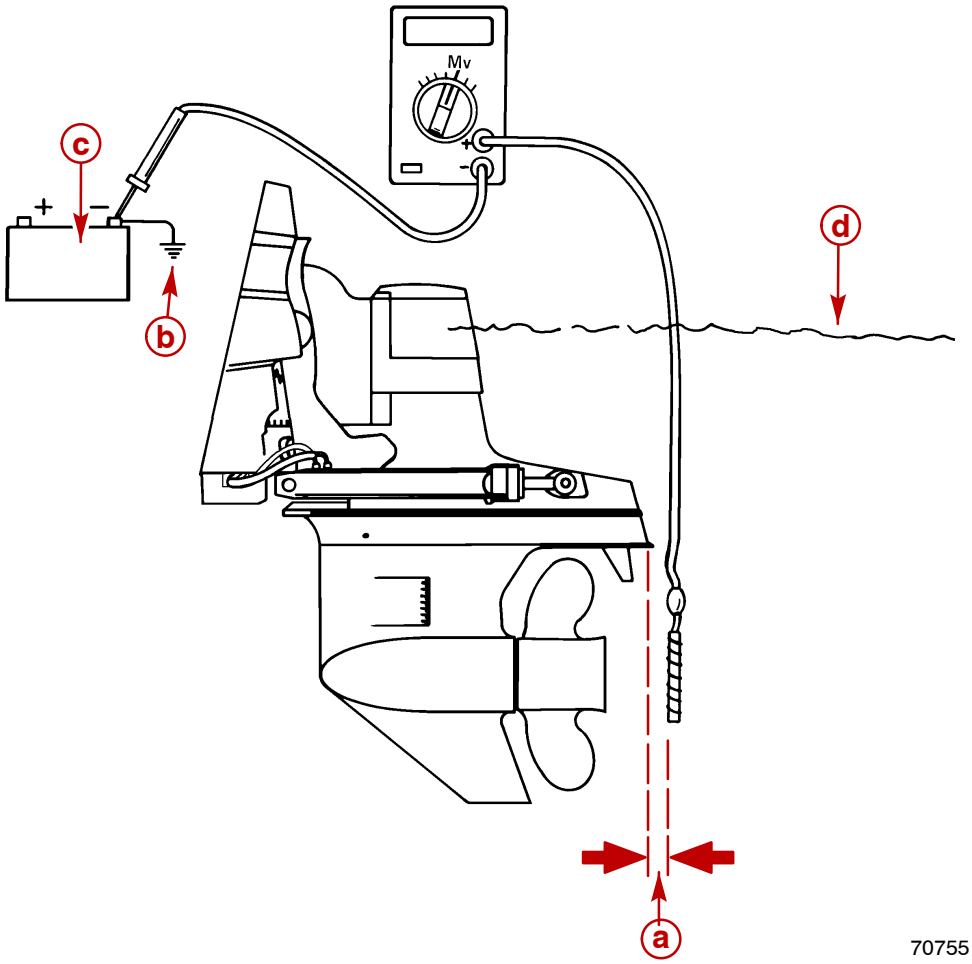


71895

Transom mounted MerCathode on boat transom

a - Anode
b - Reference electrode

Test Equipment Set-Up



a - 15 cm (6 in.) maximum
b - Power package ground
c - Battery
d - Waterline

Low Readings

Cause	Special Instructions
Loss of continuity between sterndrive unit components and negative (-) battery terminal.	Ensure that continuity devices are not missing or damaged and that connections are clean and tight.
Shore power green safety grounding lead not isolated from the power package ground on boats equipped with shore power.	Disconnect shore power and verify if reading increases. If so, install a Quicksilver Isolator 888557Q01 or an isolation transformer.
Underwater metal parts on the sterndrive unit and/or boat are unpainted or the paint is in poor condition. The boat has more exposed metal than the anodes and/or MerCathode System can protect.	Prime and paint underwater metal parts. This will reduce the load on the anodes and/or MerCathode System.
Anodes painted.	Remove paint or replace anodes.
The anodes are improperly grounded or inactive.	Clean anode mounting surface or replace anodes if they have oxidized.
Anodes consumed (no longer protect).	Replace anodes if eroded 50% or more.
Sterndrive unit and/or boat bottom painted with anti-fouling paint containing copper or tin.	Avoid any electrical interconnection between the Mercury MerCruiser product, anodic blocks, or MerCathode System and the paint by allowing a minimum of 40 mm (1-1/2 in.) of UNPAINTED area around these items on the transom of the boat.
MerCathode reference electrode or anode painted.	Remove paint.
Anodic heads used instead of plastic caps.	Reinstall the plastic caps.
No power to MerCathode controller.	Connect the positive (+) volt meter lead (set on 0-20 volt scale) to the positive (+) controller terminal and the negative (–) volt meter lead to the negative (–) terminal. The meter should indicate battery voltage. Check for a blown fuse (if equipped) on the starboard MerCathode System. Clean the connection or repair wiring as required.
Poor connection between reference electrode lead (BROWN) or anode lead (ORANGE) and MerCathode controller.	Clean and/or tighten the connection. Repair the wiring.

Low Readings (continued)

Cause	Special Instructions
Faulty MerCathode reference electrode.	Disconnect the reference electrode lead (brown) from the controller “R” terminal. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (–) meter lead to the negative (–) battery terminal. Note the meter reading; then repeat the test using a MerCathode Reference Electrode Tester 76675T1. You should obtain the same reading in both cases. If not, replace the reference electrode.
Faulty MerCathode Controller.	With anode and reference electrode leads connected to the controller, connect the jumper wire between “R” and negative (–) terminals on the controller. Connect the positive (+) lead of the volt meter (set on 0-20 scale) to terminal “A” on the controller. Connect the negative (–) meter lead to the negative (–) controller terminal. Reading should be as follows: ● **Freshwater Areas -** 750 - 1050 millivolts ● **Saltwater Areas -** 850 - 1050 millivolts If the reading is low, replace the controller.
Additional corrosion protection required. Boats equipped with a sizable amount of underwater metal (stainless steel prop, after planes, etc.), or that are moored in an area with warm or rapid flowing water may require additional protection.	Install additional anodes or MerCathode System 88334A2. If the unit is already equipped with a MerCathode System, a second system may be required.

High Reading

Cause	Special Instructions
Stray current corrosion. If an electrical current flowing along a metal conductor leaves the metal for a water path, it will cause ionization of the metal, and an area of rapid corrosion.	Observe the reading while disconnecting the electrical components one at a time until you eliminate the high reading. Correct the course of stray current.
Poor connection between MerCathode reference electrode lead (BROWN) and “R” terminal on controller.	Clean and/or tighten connection. Repair wiring as required.
Faulty MerCathode reference electrode.	Disconnect the reference electrode lead (BROWN) from “R” terminal on the controller. Connect the lead to the positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect the negative (–) meter lead to the negative (–) battery terminal. Note the meter reading; then, repeat the test using MerCathode Reference Electrode Tester 76675T1. Both tools should produce the same reading. If not, replace the reference electrode.
Faulty MerCathode controller.	Replace the controller.

Normal Reading But Corrosion is Evident

CORROSION ON THE ENTIRE STERNDRIVE UNIT

Cause	Special Instructions
The sterndrive unit is raised so that the sacrificial anodic trim tab is out of the water.	Leave the sterndrive unit in the IN/DOWN position when the boat is moored to ensure the trim tab is in the water, providing protection.

CORROSION PROBLEM DEVELOPED AFTER REFINISHING THE STERNDRIVE UNIT

Cause	Special Instructions
A steel wire brush was used to clean the aluminum casting. Steel particles became entrapped and set up a small galvanic cell.	Use only a nylon or bristle brush.

PAINT BLISTERING ON STERNDRIVE UNIT

Cause	Special Instructions
Battery charger, using 110 volt shore power improperly connected to the battery.	Ensure the charger is connected correctly.

Normal Reading But Corrosion is Evident (continued)

TRIM CYLINDER CORRODING

Cause	Special Instructions
Continuity lost between trim cylinder and sterndrive unit.	Install proper continuity devices.

ONLY ONE OR TWO COMPONENTS CORRODING

Cause	Special Instructions
Continuity lost between sterndrive unit and components.	If not already done, install Continuity Circuit Kit 99940A2.

CORROSION IN THE EXHAUST OUTLET AREA

Cause	Special Instructions
Exhaust gas deposits accumulating on the sterndrive exterior can result in paint blistering and corrosion.	Remove deposits with marine or automotive wax.

CORROSION OCCURS AFTER THE UNIT IS REMOVED FROM THE WATER

Cause	Special Instructions
Salt crystals remaining on the surface of the sterndrive components combine with high humidity to cause electrolyte formation, resulting in corrosion.	Wash sterndrive exterior and flush sterndrive interior with fresh water.

CORROSION BETWEEN SURFACES

Cause	Special Instructions
Salt buildup between surfaces.	Protect mating parts with lubricant.

Description	Where Used	Part Number
Special Lubricant 101	Propeller shaft	92-802865A1
2-4-C with Teflon		92-802859A1
Perfect Seal		92-34227-1

ALUMINUM CORRODING IN LUBRICATED AREAS

Cause	Special Instructions
Graphite in the lubricant.	Never use lubricants containing graphite because they accelerate corrosion. Use specially formulated marine lubricants.

Description	Where Used	Part Number
Special Lubricant 101	Propeller shaft	92-802865A1
2-4-C with Teflon		92-802859A1
Perfect Seal		92-34227-1

Normal Reading But Corrosion is Evident (continued)

STAINLESS STEEL COMPONENTS CORRODING

Cause	Special Instructions
Foreign matter (fishing line, marine growth, etc.) covering the steel and starving it of oxygen. This causes a breakdown of the protective oxide film and subsequent corrosion (known as oxygen starvation corrosion). Burying stainless steel in sand or silt can also cause this problem.	Remove foreign matter and prevent surfaces from being covered by sand or silt.

STAINLESS STEEL PROPELLER CORRODING

Cause	Special Instructions
Continuity lost between propeller and propeller shaft.	Clean the mating surfaces on the propeller, propeller shaft, and attaching parts. If applicable, install a continuity washer. Lubricate the propeller shaft before reinstalling the propeller.

Description	Where Used	Part Number
Special Lubricant 101	Propeller shaft	92-802865A1
2-4-C with Teflon		92-802859A1
Anti-Corrosion Grease		92-802867A1
Perfect Seal		92-34227-1

PAINT BLISTERING - THE METAL UNDER THE BLISTERED PAINT IS NOT PITTED

Cause	Special Instructions
The surface was not properly prepared before paint was applied.	Sand the surface down to bare metal, prime and repaint with Quicksilver Spray Paint.